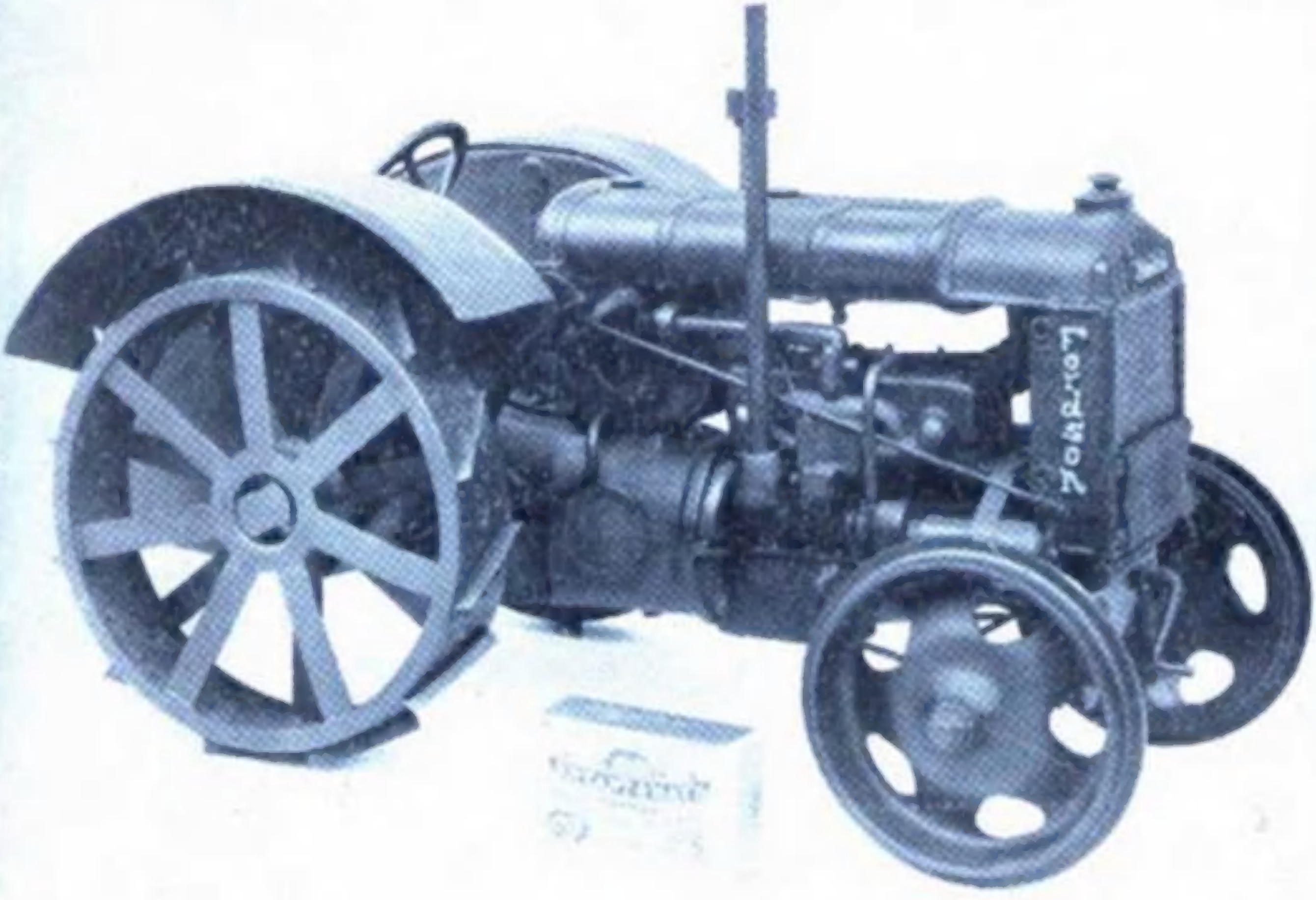
THE MODEL ENGINEER



MARCH 5th 1953

Vol. 108 No. 2702

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THE MODEL ENGINEER

EVERY THURSDAY

Volume 108 - No. 2702

MARCH 5th, - 1953

ESTABLISHED 1898

PERCIVAL MARSHALL & CO. LTD. 19-20 NOEL STREET · LONDON · W·1

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Our Cover Picture

Modern mechanised farming presents many items of interest to model engineers, but although the older types of agricultural implements, including traction and ploughing engines, portable engines, threshers, etc., have received a fair share of attention among constructors, little has been done to model the more up-to-date type of equipment. No doubt this is accounted for to some extent by the lack of exact data on the design of such equipment, and the fact that the logical tendency to enclose the working parts of machinery tends to detract from the mechanical interest. The motor tractor is now an established and familiar object of the countryside, and it should not be at all difficult for anyone in a rural district to obtain details of its design sufficient to enable an accurate model to be constructed. While it is admittedly more difficult to make a true working model of such a machine, including its multi-cylinder i.c. engine, it is not impossible, and designs for suitable engines have been published in *The Model Engineer*. The particular model of a Fordson tractor shown here is not complete in working detail, having been built primarily for exhibition purposes, but in appearance at least it is fairly accurate to scale.

SMOKE RINGS

The Power of Language

IN THE "M.E." for 1906 we came upon the following quotation from an American journal: "A correspondent writes to enquire if it would not tend to greater respect for mechanical pursuits if it were more generally known that, when a man grinds a tool on an emery wheel, he removes the surplus material scintinously, by the abrasive action of the periphery of an annular, agglutinate agglomeration of granulated adamantine spar?"

Would that some of the modern Americanisms in the English language could sound more like that!

A Helpful Suggestion

MR. S. J. APPLEWHITE, hon. secretary of the Burton-on-Trent Model Engineering Society, has written to suggest a scheme to help any members of model engineering societies who may have suffered loss through the disastrous floods in East Anglia. He writes:

"It has been suggested that there may be members of model engineering societies who have suffered severely by loss of equipment or models, losses which may not be covered by insurance or recompensed from official sources.

"With this idea in mind, the members of my society have wondered whether it would be possible, under the auspices of THE MODEL ENGINEER, to formulate a scheme whereby the many societies in the country could help their less fortunate brethren.

"Should this scheme be considered to be practicable, then my society, although by no means wealthy would be glad to contribute £5 0s. 0d. to a fund. It is suggested that the proceeds of such a fund should be allocated at the discretion of recognised model engineering societies in the areas affected by the floods."

We are sure that this idea will be regarded sympathetically by members of model engineering societies everywhere, but the success of such a scheme obviously depends upon two or three unknown, but vital factors: (a) How many societies have suffered loss as a result of the floods? (b) What is the extent of their loss, in terms of money? (c) What is the total amount that would become available in the event of a definite appeal being launched? Each of these questions is largely dependent upon the others.

We are prepared to collect any information on these points, with a view to putting the matter on an official basis, and we invite the secretaries of societies to advise us of the amounts that they would be prepared to contribute to the suggested fund. We would also like to know how many societies have sustained pecuniary loss as a result of the floods and by what amounts. With this information in hand, we could decide whether to launch the scheme.

Gauge "1" Dimensions

IT IS a matter for considerable satisfaction that the problem of universal standard dimensions for gauge "1" wheels and track has been successfully solved by the Gauge "1" Model Railway Association. The matter has been the subject of discussion and close investigation for some years, first by the Association's committee and then by a specially appointed sub-committee. The latter drew up a questionnaire which was sent out to all members. The information gathered in this way revealed the astonishing fact that no fewer than 17 different standards were actually in use!

The sub-committee drew up a very comprehensive report for presentation to the full committee, and as a result, two sets of dimensions have been recommended for the consideration of the British Railway Modelling Standards Bureau. There is little doubt that the Association's recommendations will meet with the final approval of the Bureau, and will be published as soon as possible.

Small-scale iron founding

By Terry Aspin

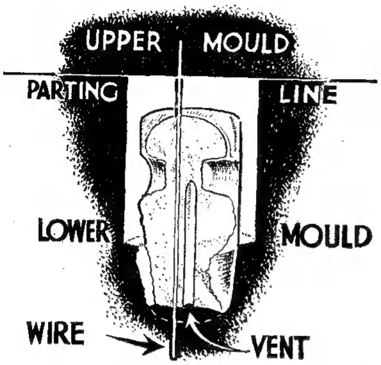


Fig. 3. Sectional sketch of mould for small iron piston, showing position of core, its reinforcing wire and its vent

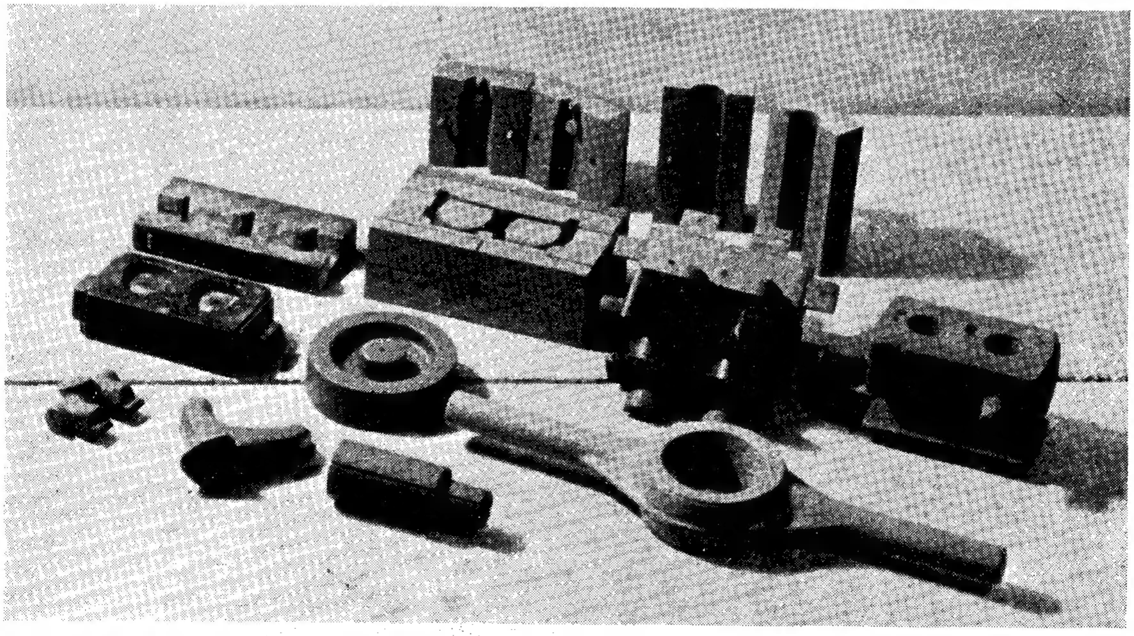
ALL of my patterns do not fall into the category of the beautifully simple. I have made some successful attempts at elaborately cored castings, by far the trickiest of these being the cylinder block for my 7 c.c. twin-cylinder model car engine. It is an o.h.v. water-cooled job and within an overall dimension of $1\frac{1}{2}$ in. × $1\frac{1}{2}$ in. × $2\frac{1}{2}$ in. it is cored out for both cylinder bores *and* their surrounding water jacket. From this particular pattern I think I poured more than twenty moulds before I was satisfied with the result. The cylinder-head for this engine is also cored for its water jacket, but it did not present quite so awkward a problem. The pistons, also of cast-iron, were cored leaving the internal gudgeon-pin bosses and a single, tiny web across the inside of the crown. Rings were machined from a short, cored tube specially cast for this purpose. This engine provided quite a fair amount of practice at foundry work.

Concluded from page 272, *February* 26, 1953.

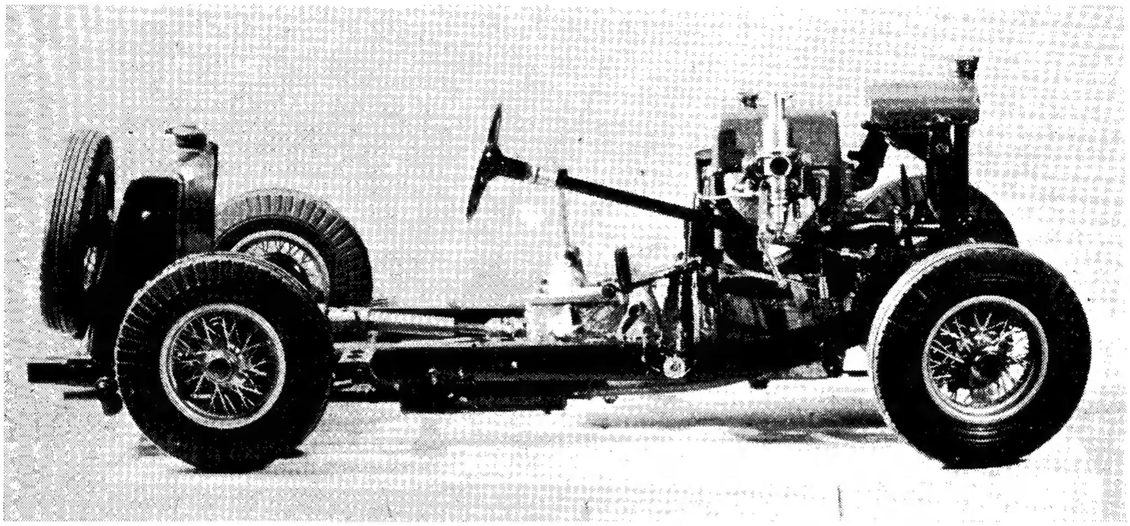
Much of my early difficulty associated with the casting of cored moulds was, of course, the result of ignorance. The core sand in my possession is specially ground material mixed with a proprietary substance (whose identity is unknown to me), for the purpose of binding it together. My first cores made of this sand caused bad blowing in the iron due, apparently, to the extremely close-grained nature of the sand and, also, to the lack of venting. Gases generated in the cores due to the surrounding iron at white heat could not dissipate in such small sections forming, instead, bubbles in the molten metal. For the remedy I am indebted to a retired iron founder who described to me the methods of venting cores, and gave me much useful advice.

Success

My experiences have since been more successful using an approximately fifty-fifty mixture of my core sand and ordinary builders' sand, the more open structure of which provides better passage to the escaping gases. Cores of a simple nature, such as those which pass straight through the mould and are embedded in the sand at either end, are easily vented by means of wires moulded into the core in its box and drawn out before baking. Those keyed to the sand at one end only can usually be vented effectively with the aid of a thin screwdriver



The patterns and core-boxes used to p oduce the iron castings for the model M.G. The cylinder block is a " waster "



The M.G. chassis, 16 *in. long, all of whose castings were produced in home foundry*

inserted almost the length of the core. More intricate shapes are best dealt with using thin, waxed string or thread. This is prepared by liberally coating with melted paraffin wax and, when set, it is embedded in the sand, with both ends protruding from the "prints," while the core is being formed. Subsequent baking of the core evaporates the wax, leaving a microscopic space surrounding the string. The latter can also be withdrawn if this can be accomplished without damage to the core.

Wire Supports

Small and fragile cores require reinforcing and supporting with iron wires (Fig. 3). Often such wires, left protruding from the core, can be used to advantage for securing same more firmly in the mould and frequently, even if they pass straight through the space to be occupied by the iron, this will cause no ill effect. They will merely be fused in and form part of the casting. An example of this would be a small cored piston. With the core left unsupported in the space formed to receive it in the mould, there would be every possibility of the incoming metal knocking it out of "plumb" with the centre of the piston. A wire passed through the core so that it enters the upper part of the mould when the box is closed would prevent this misalignment.

Small "self" cores are also rendered less liable to damage if reinforced with carpenters' pins before the pattern is removed. By self cores I mean those left in the moulding sand itself by hollows and openings in the pattern. I give as an example the sand which will be left between the spokes of a handwheel (Fig. 4). There would probably be a tendency for this to adhere to and come away with the pattern when the latter is withdrawn. By pushing small nails into the sand between the spokes before rapping, the removal of the pattern is facilitated and the strength of the mould increased at the same time. Small cores like this can also be advantageously vented with the aid of the old faithful screwdriver.

For my moulding I was fortunate in being able to obtain a supply of sand ready prepared. I have about a hundredweight of used stuff from the floor of the shop and about half that amount again, which I keep separate, straight off the mill. At one time I did attempt to mix some for myself but I must have included an overdose of coal dust which had an adverse effect on the skin of the castings. Generally I keep using the burnt sand over and over again but it does deteriorate and, to obtain an especially good finish it is well to cover the pattern first with a layer of new sand and fill up the box with the old. Without having gone into the matter very deeply, I have good reason to believe that various proprietary "mould-coats" are available as an improved substitute for graphite, which would help to impart a much higher finish to the work. Photographs of my own castings, however, will show that the finish imparted with graphite alone is quite respectable and, given a good brushing with a wire brush before machining, very little foreign matter remains to damage the tool.

Here another word on fettling. In full-size practice, I believe, it is usual to knock away the runners and risers with a sharp blow from a hammer. This treatment is not recommended for small castings produced in the amateur foundry. There is always a risk that the work will be broken into. Risers may be sufficiently thin to break off, but it is wiser to use a hacksaw on the runners.

To make a mould in which iron is going to be cast, I always find it best to pack the boxes as lightly as possible without, of course, running the risk of the sand falling out when the boxes are lifted. The sand is thus left more porous to allow free passage to the gases. Venting

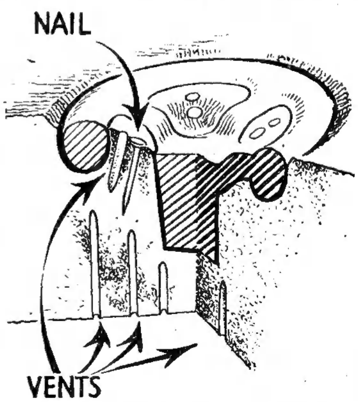


Fig. 4. Pattern of hand wheel ready to be rapped, showing core between the spokes nailed and vented

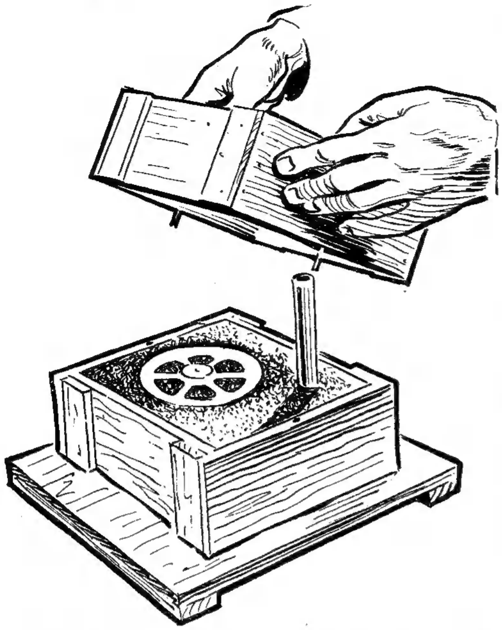


Fig. 5. The " drag " ready to receive the " cope ", in technical language, with runner tube in position

the sand above and below the pattern is also particularly important. When using wooden flasks, it is well to space the pattern at least half an inch from the edge, both to reduce the risk of a runaway and to avoid scorching. For castings up to the capacity of the crucibles described, I find a half inch runner adequate. This is formed by pressing the end of the brass tube vertically into the sand to the depth of about an inch a similar distance from the exposed face of the pattern as it lies in the bottom box (Fig. 5). Before the mould is parted prior to the removal of the pattern, the runner is formed by drawing out the tube. It is convenient to make it trumpet-shaped by cutting a mouth at the top with a trowel and rotating the tube in the sand to widen the neck.

Quite a large proportion of the patterns I make myself are known as " oddsides." That is, they possess no flat side upon which they can be rested on the moulding board, neither are they split in two on the centre-line, but they have to be divided between the upper and lower part of the box during moulding. At first my efforts to mould such patterns were pathetic. Any matter I had been able to read on the subject seemed to involve filling and emptying one or the other of the boxes twice, which I regarded—as a lazy man would—as being unnecessarily involved for the sizes of pattern to be handled. Early attempts at side tracking the problem even led me to try pressing the patterns into the sand, which is, of course, really quite impracticable. Gradually however, a procedure was evolved that works very well in practice. I have never seen the method described in any literature on the subject, so it is probably worth a few words here. My success at it has probably led me to make more " oddside " patterns than, perhaps, I otherwise would have done.

One essential is that the pattern must be designed with a view to it being moulded in this way, and this condition passes right back to the designing of the tool or model itself. As far as is practicable it must be produced with one half of the pattern (although not literally a half, I regard the " halves " of a pattern, respectively, as those parts moulded in the upper and lower portion of the box) plain enough to draw clean, as described earlier in the text, when the mould is split for ramming.

This side of the pattern (in lieu of a flat one) is placed face down-

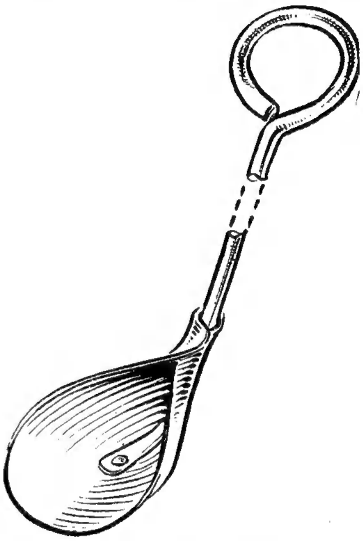


Fig. 7. Simple form of " spoon " required for skimming the molten iron. They burn away rapidly, so must needs be cheap and easy to produce

wards on the moulding board, (Fig. 6). It may have to be supported with strips of wood to keep the " centre " line approximately level and, before the bottom box is inverted over it, further packing of a similar thickness should be placed on board surrounding the pattern for the box to rest upon. This part of the mould is then rammed and vented in the usual way. When it is reversed, it will be found that the wooden strips have left the sand quite level with the pattern projecting just the right amount and, with only a little cleaning up with the trowel, it will be ready to receive its dusting of parting sand and its runner tube before the top box is placed in position and the mould completed.

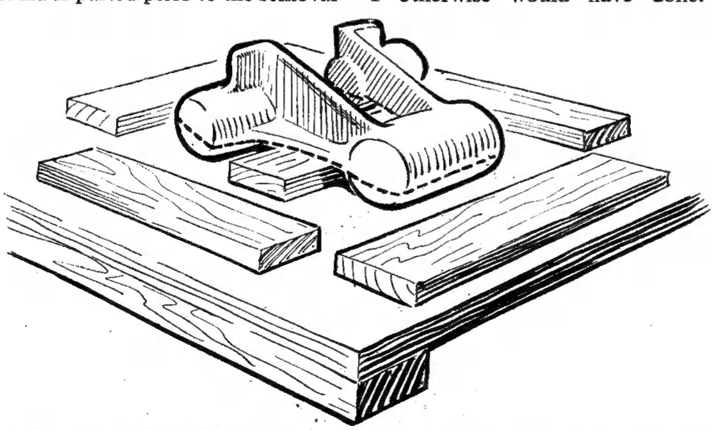


Fig. 6. A typical " oddside " ready to be moulded, surrounded by strips of packing. The dotted line indicates the approximate position of the parting between the boxes

Talking about Steam—

NO. 15. THE FOWLER "BIG LION" ROAD LOCOMOTIVE

By W. J. HUGHES

DIFFERENT people have different ideas about making crankshafts ; some prefer to turn them from the solid, while others fabricate them. In the case of the Fowler, the former method would certainly provide a nice exercise in setting out and turning, with its two cranks at 90 deg., its four valve-eccentrics, and its pump eccentric. So for the man who likes that sort of thing, jolly good luck to him, and may he not make a slip when it's nearly finished !

However, Stan Green has built his crankshaft up in an ingenious manner, and, personally, I cannot see any snags in it at all. Fig. 59 is prepared from Stan's own drawing of his shaft, without the eccentrics and gears, of course, and Fig. 60 shows how the shaft is actually built up. Photograph No. 26 shows the shaft, complete with balance weights and eccentrics.

Each end carries its own crank, and the centre section is pressed into the inner crank webs. A hole is then drilled through each web into the shouldered-down ends of the centre section, tapped 5/32 in., and Allen grub-screws are fitted to key the parts together and to help to resist the turning strain.

To ensure that all parts of the shaft line up correctly, the following method was used. The webs having been drilled and reamed to $\frac{7}{16}$ in. diameter, the crankpins were turned to $\frac{1}{2}$ in. diameter, with the ends shouldered down to be a press fit in the holes.

Now, looking at Fig. 61, we see that the steel forming the outer end of the shaft is turned between centres with an extra length shouldered down to $\frac{7}{16}$ in., the latter being marked "*XX*" in the sketch. Part *AA* is left oversize.

Part *XX* is a good, but not *too* tight, fit in the hole in the inner web, but the last $\frac{1}{4}$ in. is left a *press* fit into that in the outer web.

The parts were then assembled, and the three "press-fit" shoulders squeezed home and brazed. Now running the shaft between centres machining of the part at *AA* was completed.

Next the part *XX* was sawn through where indicated in Fig. 61, and withdrawn from the inner web, leaving the hole perfectly lined up with the shaft. The other half of the shaft, with its crank, having been made similarly, the whole shaft was completed, as outlined

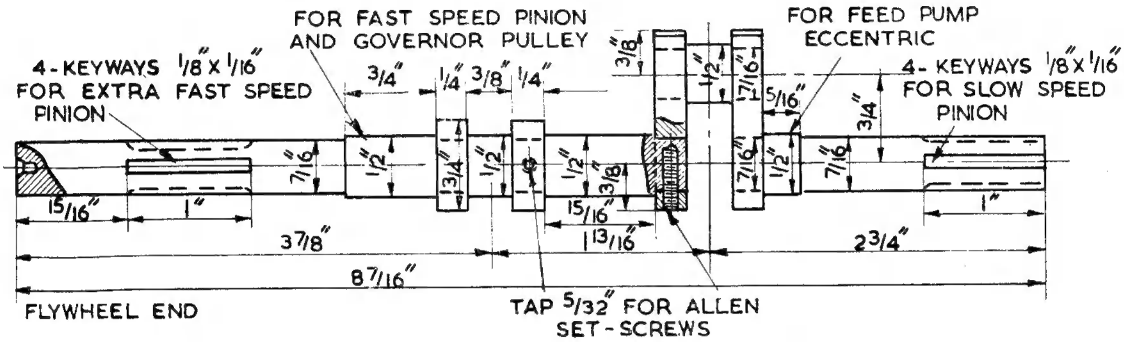
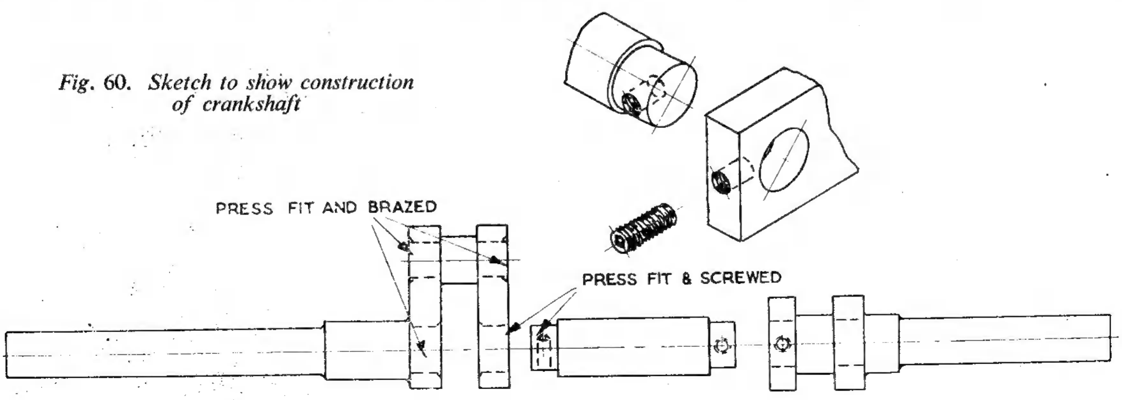
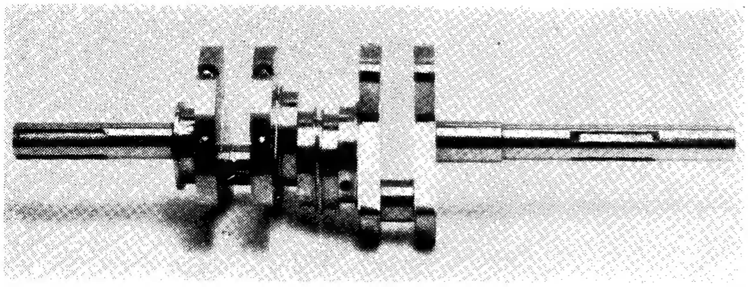


Fig. 59. Crankshaft dimensions for $1\frac{1}{2}$-in. scale "Big Lion"

Fig. 60. Sketch to show construction of crankshaft





Photograph No. 26. Balanced crankshaft, with eccentrics, for the $1\frac{1}{2}$-in. scale Fowler " Big Lion " road locomotive

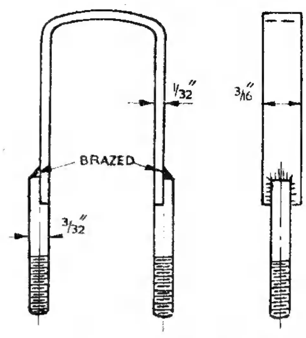


Fig. 63. Construction of strap

earlier. Of course, anyone following this method should not forget to thread the four eccentrics on to the centre section before final assembly !

Balance Weights

The " Big Lion " crankshaft has separate balance weights which are secured by straps, and these are shown in side elevation in Fig. 62. The straps are made as shown in Fig. 63, being strips of steel $\frac{3}{16}$ in. wide by 1/32 in. thick, brazed to screws 3/32 in. diameter. It might be advisable, however, to make the straps $\frac{1}{16}$ in. thick, and to mill grooves $\frac{3}{16}$ in. wide and 1/32 in. deep round the three sides of the webs, so that the straps fitted into the grooves. This would give added security, of course.

The screws pass through holes in the balance weights, their nuts being recessed into the outer edge of the latter, as in Fig. 62. It is important, of course, to drill the holes for the screws in the balance weight before cutting out the recess in the latter, which fits (tightly, please !) over the inner ends of the crank web and also of the strap.

Eccentrics

The valve eccentrics are shown in Fig. 64, and it will be seen that they are held in place on the shaft by Allen set-screws. As previously mentioned, the throw is $\frac{1}{2}$ in., giving a cut-off of about 80 per cent. in full gear. (I should have mentioned, by the way, that the valve lap is a gnat's whisker more than 3/32 in.)

Shown in Fig. 65, the eccentric for the feed-pump is similarly clamped to the shaft, but the throw is only $\frac{3}{8}$ in.

Gearing

Some of the gears were shown in Photograph No. 22 (last article), but it should be mentioned that the bevel wheels and pinions shown in that picture have not been used for the compensating gear, as they are not to scale. Stan is using bevel wheels of 4 in. pitch diameter and 10 pitch (40 teeth), with pinions of 1 in. pitch diameter (10 teeth), which come very close to the scale sizes.

Fig. 66 gives the layout of the shafts and gearing with the second and third speeds (fast and extra-fast speeds) shown in Fig. 67 : the plan of the gearing—not strictly to scale—is given in Fig. 68. The change-speed gears *A*, *B*, *G*, *H*, *I* and *J* are all 16 pitch, as are *C* and *D*, the second motion pinion and third motion spur wheel ; the final drive (road spur pinion and wheel) are both 8 pitch. Pitch diameters and number of teeth are shown on the drawings, so need not be detailed here.

Incidentally, our Canadian friend is not fitting springing to the hind axle, which avoids a good deal of complication, of course. Nevertheless, it *can* be done, as was demonstrated by Mr. Taylor in building the beautiful Fowler which he exhibited at the 1952 " M.E." Exhibition. You will recall that the method of springing the prototype was described and illustrated in THE MODEL ENGINEER for November 13th, 1952.

Photographs

The photographs of the other Fowler " bits and pieces " given herewith are of Mr. Jaques' $2\frac{1}{4}$-in. scale model which I mentioned in the previous article. Anyone who knows Fowler practice will agree that they do look like the real thing : the connecting-rods with forked little-ends and cottered big-ends : the cylinder covers with slide-bar brackets : and the cross-head with cottered brasses.

Incidentally, in a recent letter Mr. Jaques tells me that he is now very busy with the boiler, and is ready to put the firebox into the shell. He concludes his letter " Fowler engines were certainly *made*." So they were, and so undoubtedly will his own be !

The other photograph shows a sight which at one time was common enough in Lancashire and Yorkshire : the transport of a large Lancashire boiler from its place of manufacture to the mill where soon it would be at work steaming perhaps a large cross-compound or triple-expansion Corliss engine, or an imposing beam-engine.

The engine is *Titan*, one of Mr. Norman E. Box's well-known fleet of road locomotives, and the hind wheels are fitted with the Boulton-

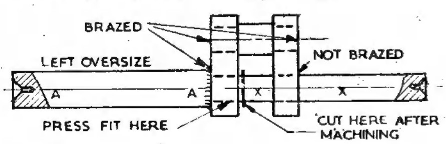


Fig. 61. How to ensure that the parts of the shaft line up correctly

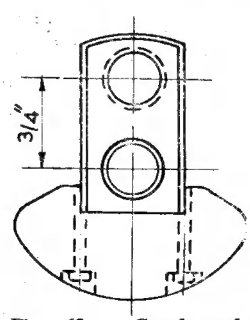


Fig. 62. Crank web, balance weight, and strap

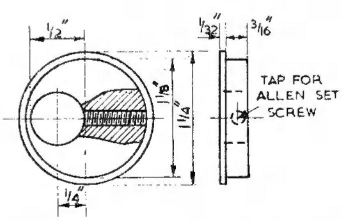
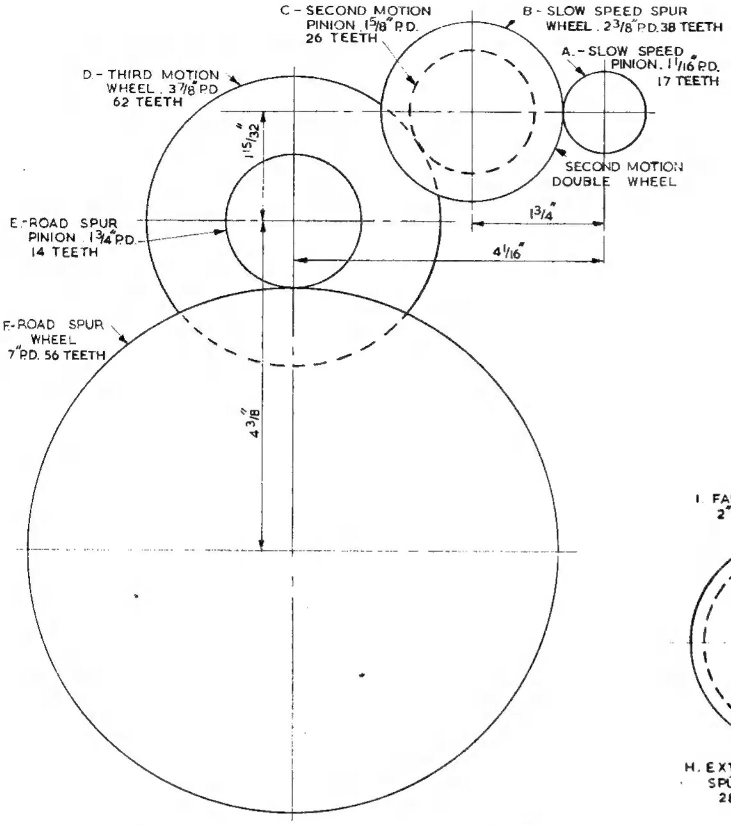


Fig. 64. Valve-gear eccentrics : four required



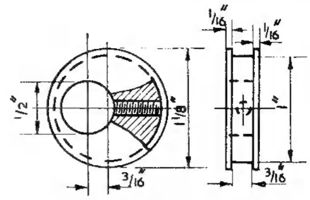
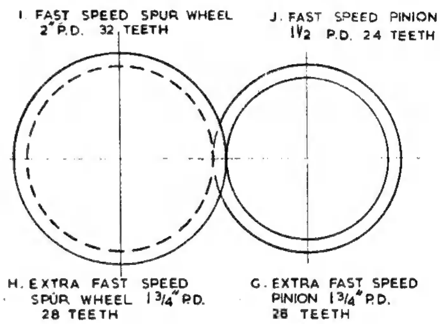


Fig. 65. Feed-pump eccentric

Left—Fig. 66. Layout and sizes of gearing for the $1\frac{1}{2}$-in. scale Fowler

Below—Fig. 67. Dimensions of second and third speed gearing



McLaren patent springing on the rims, sometimes called "elephant's feet." Wood blocks, with end grain to the road surface, were fitted into sockets cast in the rims, each block being individually sprung. Thus road shocks were damped out to some extent, and I am informed that this type of wheel was highly approved by highway engineers, who were not so keen on the more usual strakes, before rubber tyres "came in."

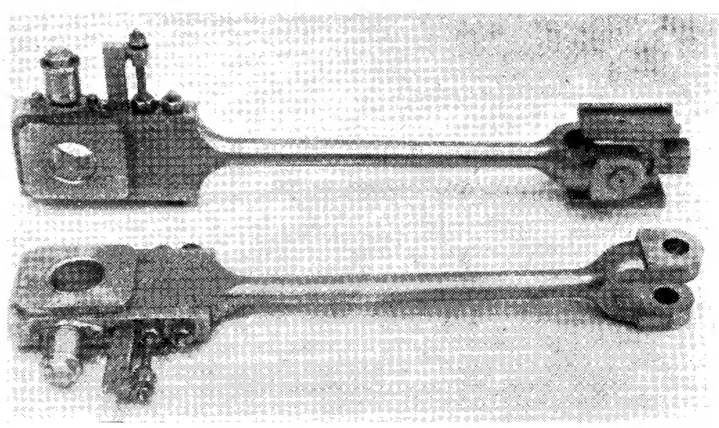
Reproduction of the photograph is by courtesy of Messrs. John Fowler and Co. (Leeds) Ltd.

More Correspondence!

In the heavy correspondence which flows to this semi-det., with all mod. convs. (and some inconvs. as well!), most of the epistles are fortunately of such a nature that a from time to time I am constrained to read suitable complimentary extracts to the better half, for sad to say (though I believe that among wives this is no uncommon thing) there are moments when her opinion of her lawful spouse does not appear to be as high as it might well be.

However, on odd occasions the postman will deliver an envelope which contains a large brickbat, though happily usually even these are padded sufficiently to avoid permanent damage to the recipient. (Did you ask if I read *these* letters out loud? What do *you* think?)

Seriously, though, it would be too much to expect that everybody agreed with one all the time, and the only type of letter I really dislike is that fortunately very rare one, where the writer dips his pen in vitriol, thinks of all the nasty things he can say, and lets himself rip, with no thought for feelings (or accuracy) whatever.



Photograph No. 27. Connecting-rods and a crosshead for R. S. Jacques' $2\frac{1}{4}$-in. scale "Big Lion"

The 2-in. Scale Marshall

A nice friendly letter came to hand recently from Mr. G. R. Jeffries, who built the 2-in. scale Marshall traction-engine which was awarded a "Highly Commended" at the "M.E." Exhibition. Mr. Jeffries considers that in my report of the engines at the show, my criticism of the Marshall was "most fair in all instances except the question of coal-rails," which I said were not standard on the prototype, and even if fitted as an extra by the makers, were quite different in appearance from his.

Now, before making this statement, I had searched through my extensive collection of Marshall photographs, catalogues, drawings, and copy-photographs, and in the few cases where coal-rails *are* shown, they are different from those on the model. I, therefore, presumed, though I said I may be wrong, that Mr. Jeffries had worked from a prototype to which the coal rails had been added locally after leaving the makers' hands.

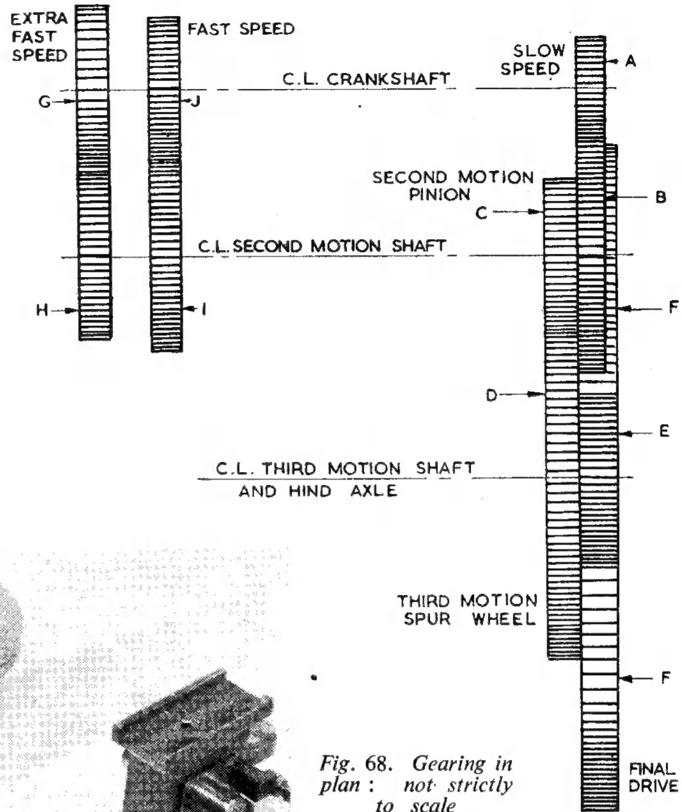
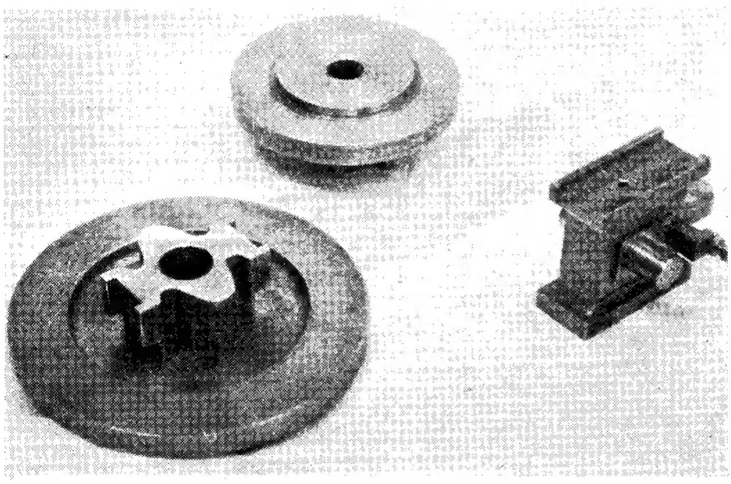


Fig. 68. Gearing in plan: not strictly to scale



Photograph No. 28. Cylinder covers and crosshead by R. S. Jacques

However, he assures me that his coal rails are authentic, being taken from official drawings of a Marshall tender, evidently different from mine. That being so I owe him an apology, which is tendered (no pun in-"tended"—Sorry !) herewith. Incidentally, Mr. Jeffries tells me that the engine has been in steam many times, and pulls very well indeed.

The 2-in. Scale Free-lance Road Locomotives

Another letter disagreeing with me on certain points in that article was from Mr. Stephen Mustill, who is an old and valued correspondent of mine. One matter he raises is the question of double high-pressure cylinders on a 2-in. scale free-lance road locomotive, which was also mentioned by Mr. C. E. Hooker in a letter from which an extract was published in a recent "Smoke Ring."

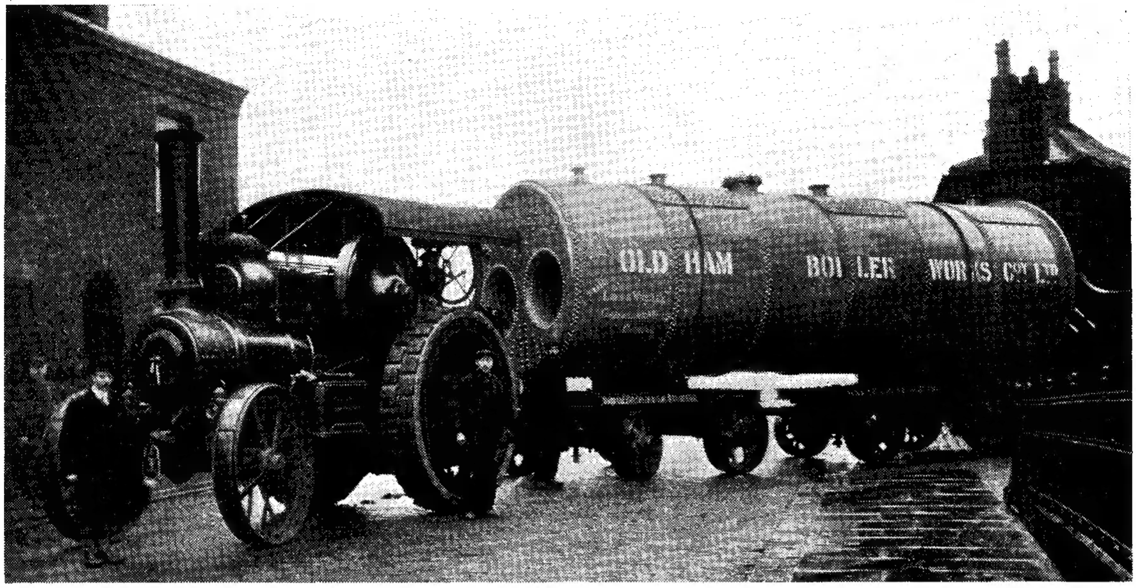
My contention was that in all major points of design, even a free-lance engine should follow prototype practice, which meant, in my opinion, that the builder was wrong in using double high-pressure cylinders : the engine should have been a compound.

Both Mr. Mustill and Mr. Hooker point out that double high-pressure engines *were* made—which, incidentally, is well known to anyone who had made any study at all of the subject !

Nevertheless, it cannot be gainsaid that a few years after the introduction of compounding by Fowlers, and after other makers had overcome their mistrust of this audacity (for which failure had been widely predicted), the compound became *the* engine for road locomotives, for economy's sake, chiefly. The vast majority of road locomotives were compounds, therefore.

Moreover, the model in question undoubtedly represented an engine of a later period than that of double H.P. cylinders, and for these reasons I still maintain that it should have been built at least to *look* like a compound.

Mr. Mustill also does not agree that a free-lance job should follow prototype practice, because, he says, "if everyone did this, design would become stagnant." Now, this might apply to other subjects, but surely road locomotive design *did* become more or less stagnant in its major points ? It isn't as if this model contained any new or revolutionary ideas !



Photograph No. 29. The good old days ! Mr. Norman Box's " Titan," with wood-block wheels, hauling a typical load

Describing another free-lance road locomotive, which, by the way, I regret I attributed to the wrong maker, I criticised the fact that it had final drive by chain, and only a single speed. Mr. Mustill says that these have both been used in actual practice before now. So they have ; but surely, Mr. M., not in a *road locomotive* of a comparatively modern period, which this model represented ?

The Editorial opinion on this subject, incidentally, is well expressed in a " Smoke Ring " of February 19th, 1953.

The same writer points out also, which I well knew, that not all Ransomes' engines have the maker's name fretted out at the back of the steersman's seat. The point here is that in the particular model I was criticising—the lovely 1-in. scale Ransomes showman's engine—it *should* have been, because it shows clearly on an " official " photograph I have of the prototype.

Hammer-Blows

To one point made by Mr. Hooker, I must take exception, when he says that " traction engines did not hammer or pound their way along the roads." Say the wheel rides on to a stone : it may crush it, or may ride over it, but in either case the wheel may suddenly drop an inch or more with a weight of a few tons on it. Travelling on an uneven and flinty country lane, or, worse still, over stone setts, the strakes are continually receiving heavy hammer-blows ! Mr. Hooker, having had fifty years' experience, cannot possibly claim that the vibrating, juddering ride on the footplate of a steel-shod traction engine on a rough road bears any resemblance to the comparatively smooth and easy action of a rolling-mill ! Certainly the rolling action of the wheels had *some* effect on stretching the strakes, but I should still say that most of it was done by the hammering and/or pounding !

On one matter I am in *complete* agreement with Mr. Hooker—" that if a person is copying a prototype and calls his model by a known name, it should fairly represent the original." That alleged ¾-in. scale so-called Burrell is always turning up at exhibitions, built by different good folk to a commercial design. It does *not* resemble a Burrell or any other make, chiefly because the proportions are all wrong, but also because some of the principal features—e.g., the gearing—are wrong, too. Since there appears to be an undoubted demand for supplies of castings and drawings of a ¾-in. scale traction, I feel that the firm in question should withdraw that particular effort, which must have paid for itself by now, and issue a pukka design which looks like what it is supposed to be.

(To be continued)

A HOBBIES EXHIBITION AT LEEDS

We learn that the West Riding Small Locomotive Society is well ahead with arrangements to hold an exhibition in Leeds during Easter week. It is to be a " Coronation Year Festival of Hobbies Exhibition," and will be held in the Corn Exchange, from April 8th to the 11th.

Mr. Dan Hollings, writing in the W.R.S.L.S. Bulletin, states : " As the title may seem to imply, there is more to it than a display of models ; the ' net ' has been widely cast and, so far, the response has been splendid. Results indicate that, in all probability, this exhibition will surpass the one we held in Leeds in 1947. Interest and novelty will be there in full measure ; e.g. one exhibit alone, of special interest to Leeds people, is a model of a famous Leeds product—the Centurion tank —a working model made by apprentices at the R.O.F., Barnbow."

We like the idea of " spreading the net " occasionally ; it helps to broaden one's outlook and most certainly tends to increase public interest, and the more the latter can be stimulated the better.

TWIN SISTERS

by J. I. AUSTEN-WALTON

I FEAR that you were left, in the last instalment, with the boiler in a somewhat nebulous state, and only a part description of its making. There should have been another drawing to go with this issue, but somehow the extreme pressure of important business has put this out of range for the moment, plus something in the nature of a seasonal epedemic which appears to have affected very nearly every household, including my own.

Going back over the pages, I see that the position is not without hope, and there are many preliminary jobs that can be started, the boiler barrel for one. Apart from its turned ends, the dome top fittings can be made, and although these have not been detailed on the first sheet, they are shown quite clearly.

Make the screwed ring and the top cap on exactly the same lines as for the steamchests. One pin spanner will then suit all the parts. I advise these parts being made in a good quality metal such as phosphor-bronze or gunmetal ; they do, after all, carry a fair amount of pressure, and something other than brass seems to be indicated. Make the threads a good fit, short of being a binding fit of course, and smear them with some graphited lubricant to prevent trouble later.

In giving the general description of how the boiler was to be assembled, we got as far as having the barrel, dome fitting, outer wrapper, inner wrapper and tubes, all stuck together. The drilling for the stays was also dealt with, and it was possible to imagine the various parts assembled and clamped in a temporary try-out.

Looking at the boiler from the backhead or open end, we can see the inner box, less its door-plate, situated inside the outer wrapper, the tubes in place, supported at the front end by the barrel tube-plate which is not yet fixed. We have all the stay holes drilled and tapped in the inner members, and with clearance holes in the outer members. We have the front section of the foundation ring merely riveted to the throat plate, and temporary packing for the side sections of the foundation ring. Very well, let us go on from there.

If the inner assembly checks up in every respect, its position is true and straight, and the water spaces are the same at both sides, you can say the job is a good one so far. The next best thing to tackle is the missing side sections of the foundation rings which may be cut and fitted to meet with the front section, and cut off square and level with the back edge of the inner wrapper and which will be, incidentally, level with the door-plate that goes inside the wrapper and flush with it. This means that the remaining section of the foundation ring will be just a straight piece to be fixed to the inside face of the backhead.

The side sections may be lightly riveted to the outer wrapper, in two places. Put the rivets about ¾ in. from each end of the pieces ; two rivets will be enough in each. Now assemble the boiler once more and apply the cramps to hold it. This will entail fitting the front tube-plate over the tube ends, and if you followed the previous advice given, you will find the second application with the tubes now set at the right positions, very much easier and quicker. The tube-plate may now be drilled for the top steam pipe in the position given. Now come back to the open end of the boiler, and make a further and most critical examination of the inside because the next operation is going to join the two assemblies up together for good. Everything in order ? Right, off we go.

The Stays

Turn up all the stays, including the roof rod stays from a good, malleable high-tensile bronze. If you just cannot get such a material then use honest-to-goodness copper —*never brass.* If you observe this, the trouble of wasted stays, or even broken stays, will never bother you. Put just a few threads on the ends, enough to go through the inside wrapper and about one thread projecting. The rest of the stay is left perfectly plain and smooth, and is cut to a length that leaves about ¼ in. projecting beyond the outer wrapper—just enough to provide a place by which to grip it when screwing in place. The threads may be left fairly slack (a fact that may surprise some people even as much as the boiler itself), but the value of this will shortly be seen.

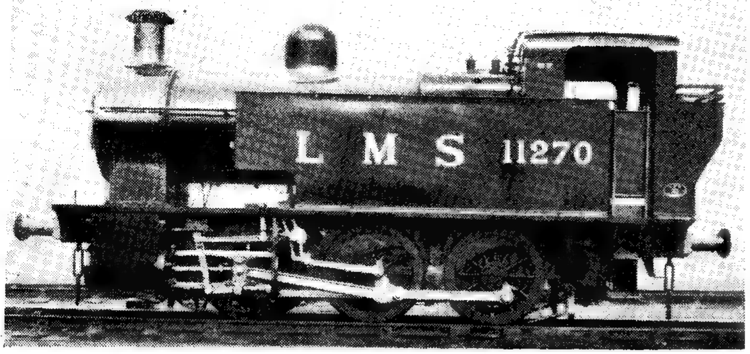
When the staying has been done, and the boiler has the appearance of a rather untidy porcupine, you will have a unique view of seeing what the staying looks like from the inside.

When I made my first boiler, taking infinite care to see that every joint was perfectly made, and using ordinary brass spelter for the brazing, which was then about the only known or available material to be had for the job, I felt a bit disgusted and not a little unhappy at the thought of having to go back to ordinary soft solder for the stays. Not only that, the stays screwed all the way down suggested a bad weakness basically, and a potential weakness where corrosion was concerned ; it seemed wrong to leave a thread where it could not be used, and when I looked up the subject of stays in an old locomotive book, and saw that these were relieved of thread in their centre portions, I tried to do the same in small scale. Only then did I realise how very weak the stay looked when denuded of its thread, so I made up larger stays with consequently fatter middles, and then got in a mess with the larger threads and their more or less scale spacing.

A Staying System

I did evolve a system of my own for staying, and tried it out on a 3½ in. boiler with a wide firebox. My flame equipment then consisted of a five-pint blowlamp and a steam blown gas pipe, sold to me by Buck & Ryan at what then seemed to be an enormous price. From memory, this was an extremely well made job, but it had its shortcomings. Whereas the five-pint blowlamp nearly melted the entire boiler, the steam operated lamp persisted in its habit of waxing and waning without warning, usually the latter when the temperature was just getting to the crucial point. I *did* manage to silver-solder about three stay heads near the foundation ring, but had it been anything other than a wide firebox, doubtless I would not have got even as far as that. I had to content myself with the usual brass wireless nuts and soft solder. There was some trouble with weeping stay heads at one period, and then the inside of the

Continued from page 143, *January* 29, 1953.



Side view of the prototype for the Twin Sisters

boiler got a bit scaled up, and the trouble was forgotten.

Now I always build a boiler in such a way that all the stay heads may be silver-soldered *with ease*, and you may now proceed to do the same in comfort The end of the boiler being left open, with no end plates in position, enables you to get a blowlamp inside the box, and with the boiler laid on its back. With the oxy-acetylene jet, it is easy. When every stay head is done, the boiler quenched and cleaned up, you can then see every stay and you will probably see a neat fillet of silver-solder inside as well as outside, especially *if the threads have been left on the slack side.* During the heating operation, when the boiler has been moving about with the changes of temperature, all the stays have been free to "breathe" or move about by sliding freely in the clearance holes left for them in the outer shell. But you do not worry about silver-soldering the stays outside just yet; you may silver-solder the door-plate and firehole ring at one heat, into the wrapper, followed by the backhead with the remaining section of the foundation ring lightly riveted to it, and of course, filed and fitted to match beforehand. Do not forget to fit the tiny copper supporting pegs where necessary to carry the door-plate itself in the inner wrapper, and one or two for the top region of the backhead—the firehole ring itself supports it lower down.

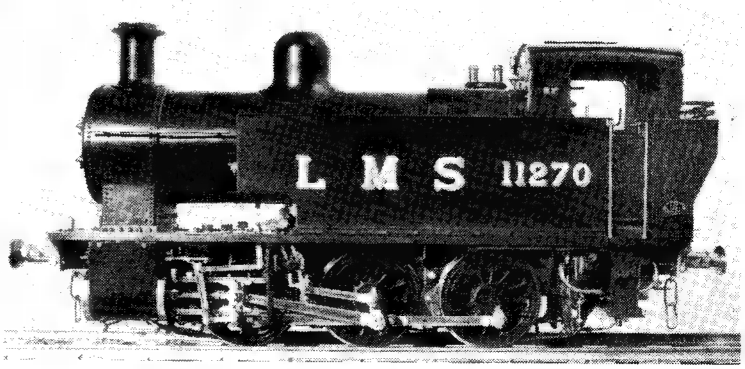
Before fitting and brazing the backhead, there are a number of pipes to shape and fit. The main steam pipe from the dome comes via a special fitting made from square bronze or even brass bar. This takes the form of an integral elbow fitting at the top and a plain through hole at the bottom; this slides over the lower or delivery pipe below and acts as a support for the top assembly. When these are made and silver-soldered together, two smaller pipes of $\frac{3}{16}$ in. diameter are also made into the fittings, and are led back with plenty of free length to pass through holes in the backhead. With the front tube-plate still left unfixed, this pipe arrangement may be made up and offered up from the front end. A moment's reflection will show that, with the roof stays in place, this cannot be done from the back or unless the pipes are set up in position before staying. The run of the two small pipes may not work out as artistically as the drawing shows, but all that matters here is that they have to clear the stays, taking the shortest route, without kinks, to the backhead pads. There is one other pipe not shown on the drawing; this is the blower pipe which runs from a simple pad on the right-hand side of the front tube plate, back to a similar pad on the right-hand top corner of the backhead. This may also require bending or setting for the same reason as given for the other pipes, and it is just as well to get the run of these before sealing up the boiler for good. The exact location of the blower pad is given on the first drawing, and is shown as 3/32 in. diameter. This gives good clearance and "fishing about" allowances when trying to find where the blessed hole is, and when you are conjuring about from the other end. The pad that goes over it and is silver-soldered to the backhead is drilled the same size as the pipe—$\frac{3}{16}$ in. diameter.

Whilst talking about pipes, some people may have noticed that the two sites for the clacks on the backhead appear to allow the feed water to spill right inside the firebox. This is not the case; the two combined steam valve and clack fittings have attached pipes made so that when the fitting is bolted up, the water is carried right to the front of the boiler barrel.

I may be asked why I did not fit girder stays to this boiler; the answer to that is clear enough, but has a history of sorts. Years ago, I happened to be with a Board of Trade inspector who was examining a couple of Lancashire boilers. One was stripped down while the other was in steam. The inspector had finished crawling about inside the first, and was standing by my side, stamping his feet and trying to brush some of the dirt off himself. He then led me to the side of the other boiler, and patted it rather affectionately. "She's the girl," he said, "and definitely the better of the two; you want to watch her shudder when they shut down those Massey hammers—you can see her plates breathe."

I laid my hand on part of the cleading, and could definitely feel a slight movement from inside, like an intermittent trembling as the

(*Continued on next page*)



Side view of the original " Twin Sister "

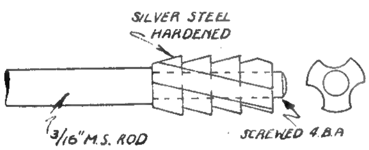
Defouling boilers

By H. S. Steele

HOW often it happens that the small locomotive enthusiast in his eagerness to get his locomotive under steam, uses ordinary house coal to fire the boiler, and often he has cause to rue his impetuosity !

In these days of shortages, difficulties in obtaining small supplies of steam coal or anthracite are comparable with those for procuring the meagre quantities of coal necessary for one's bodily comfort and peace of mind. The unsuspecting small-locomotive tyro can scarcely be blamed if, in his blissful ignorance of the consequences, he breaks up a lump of the precious household supply for steaming his pet. He fails to realise how quickly ordinary house coal chokes up the boiler tubes with soot and hard carbonaceous deposits.

The soot can be removed easily enough with a soft tube brush or an improvised pull-through, although



it is an extremely messy business. The harder deposits cannot be so readily shifted, however, and if allowed to remain, the steaming capacity of the boiler is sadly impaired.

A stiff wire brush will shift the hard deposits, but here again there is difficulty in getting just the right article. The 0.303 in. rifle pull-through is ideal—if you can get one—for thin-walled $\frac{3}{8}$-in. tubes. Usually the wire brush obtainable in shops is either too large, too small, or too soft. A brush too large readily jams tightly in the tubes and is difficult to shift ; too small a brush is not very effective.

The Tool

Having had the boiler of one of my small locomotives well and thoroughly coked up by an unsuspecting friend who used house coal, and being unable to get a suitable brush to clean the tubes, I made a tool as shown in the accompanying sketch, suitable for the $\frac{3}{8}$ in. diameter tubes. It soon shifted the hard deposits with a gentle turning movement followed by a few fairly vigorous pullings-through. As it is rather important to have the diameter of the business end of the tool just right, it is advisable to measure the internal diameter of the tubes and then allow about 5-thous. clearance.

The head is grooved circumferentially about 3/64 in. deep as shown, with a suitable tool in the lathe, drilled and tapped 4 B.A., and three grooves are filed on the skew lengthwise with a rat-tail file. Use silver-steel for the head and harden out in oil. A 2 ft. length of $\frac{3}{16}$ in. round M.S. rod bent to a ring to form a handle at one end and screwed into the head at the other end provides a convenient mounting.

The superheater tubes present less difficulty in cleaning, for it is easier to get a suitable wire brush. Moreover, these tubes seem to be less prone to accumulate the hard carbonaceous deposits. It is, of course, advisable to remove the superheater elements to ensure that the superheater tubes are properly cleaned, should decoking operations become necessary.

TWIN SISTERS

(*Continued from previous page*)

works requirement and demand varied from second to second. "A boiler that is not too stiff and rigid, is always a *safe* boiler," the inspector continued, "and during the last thirty years or so, the only boilers with cracked plates and other troubles that have come my way, were caused by masses of ironmongery inside that should never have been there." He continued to recount some of his other experiences, most of which I have now forgotten; but the main point of his talk has always remained with me.

I like to build a boiler with a good, stiff outer shell, and where the gauge of the metal does not take away from heating conductivity as it would on the inside surfaces. Inside this, I suspend the entire inner works in such a way that uneven heating and expansion may be taken up without tearing things apart—or trying to do so. Bar stays definitely do not do so, and correctly placed will carry as much or more strain than any girder stays yet designed. Not only this, girder stays conduct far too much heat away to the outside skin, and they interfere with the natural internal water circulation of the boiler. The story about the wasting away of bar roof stays is just a legend that has no foundation in fact. A suggestion that some sort of corrosion affected them, would be as apparent in the case of girder stays, even if it took somewhat longer for that corrosion to weaken them to any appreciable extent. If it is corrosion that eats the stays, why does it not attack the the other shorter, but still *bar stays* in the sides of the firebox ? Perhaps the steam and water is much purer down below.

No Noises

If the inside of a boiler is correctly mounted, there will be no more ominous "pings" and "plongs" from its intestines when the hydraulic tests pressure reaches up to the 300 mark. *Of course*, the boiler must stretch and adjust itself when so tested, especially as half the copper has been left in a soft condition following the various brazing operations. Slight dents and dimples *may* appear on the inside of the firebox crown sheet and other relatively flat surfaces, between stays, and this is *expected* when the copper is almost putty-soft. When they are gently tapped back, the metal work-hardens immediately, and a repeat of the same test pressure brings no re-occurrence. But a "ping"—especially a rather loud and clear one may be anything, even a broken stay somewhere, and you will never know where it is unless an extra large bulge proclaims itself.

I like to play for safety every time, rather selfishly, because I sit a long time behind small boilers in steam, and would hate to find parts of a firebox nestling on my lap, or burning a hole in my neck. If you have no confidence in your own boiler work, you will never have happy days on the driver's seat.

(*To be continued*)

L.B.S.C.'s "Britannia" in 3½ in. Gauge

● FOOTPLATE FITTINGS

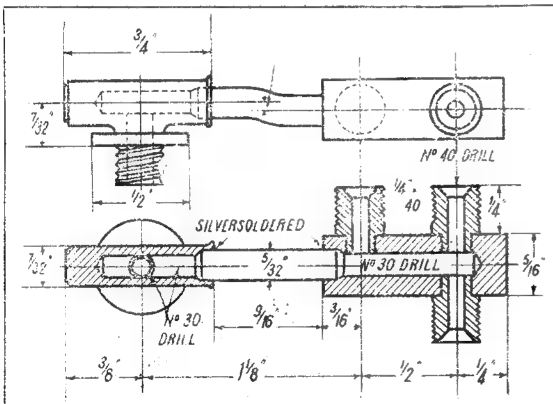
THE various blobs and gadgets which adorn the backhead of our little *Britannia* are no more difficult to make and erect, than those on *Tich* or *Invicta* ; they are just a little different in detail. All are plain straightforward jobs, with no fancy frills ; their only claim to distinction, is that they have been approved by more than one "full-size" chief mechanical engineer, and that is recommendation enough for Curly. The pipes on our little engine are inside the cab instead of outside, for sake of neatness. To be efficient, they would have to be much larger than "scale," and would give the engine the clumsy appearance of the old-fashioned jobs that were on sale when I was a small kiddy. However, I have included the outside turret, directly coupled to a manifold under the cab roof. It has no shut-off valve ; because, for one thing, the valve is not necessary on the small engine, and secondly ; you couldn't get at it under the cab roof. By the way, I often wonder what happens in the outside pipe work on the full-size engines, when one is heading north at a tidy lick, in a real blizzard, among the Cumberland hills. Had your humble servant designed the plumbing on the Class "7s", there would have been no exposed pipes ; 'nuff sed !

Combined Turret and Manifold

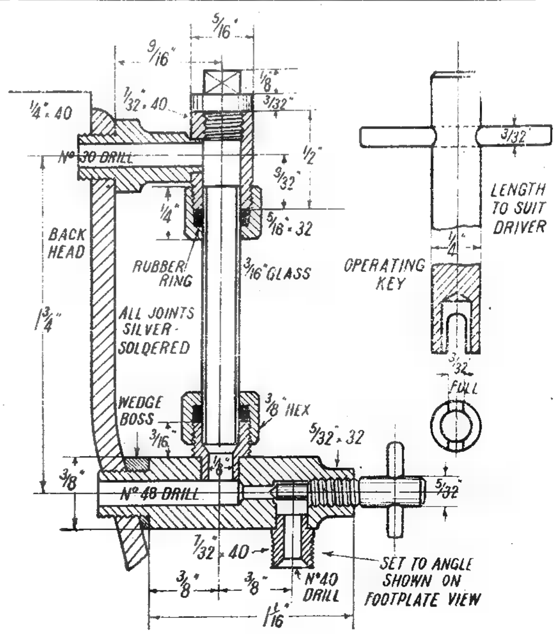
The turret can be a casting of the shape and dimensions shown, or it may be built up. If cast, it will have a chucking-piece opposite the spigot. This is chucked in the three-jaw, setting the spigot to run truly ; turn down the spigot to $\frac{5}{16}$ in. diameter, face the flange, and skim to size. Screw the spigot $\frac{5}{16}$ in. × 32 centre, and drill to $\frac{7}{16}$ in. depth with No. 30 drill. Chuck the plain end of the barrel in the three-jaw, setting the beaded end to run truly ; face, centre, drill No. 30 until the drill breaks into the other hole. Open out the end for about $\frac{1}{8}$ in. depth, with a No. 23 drill. If the casting is rough, smooth all over with a file ; remove chucking-piece.

If rod material is used, turn the barrel part from $\frac{5}{16}$-in. round rod held in three-jaw, turning to dimensions shown in the illustration, and drilling and opening out, same as for the casting. Good quality bronze or gunmetal rod should be used for all built-up fittings ; if not available, use the best brass rod that you can get. The spigot and flange are turned from $\frac{1}{2}$-in. rod held in the chuck ; part off at $\frac{1}{4}$ in. from the shoulder. Rechuck in tapped bush held in three-jaw ; turn down about 5/32 in. length to $\frac{1}{4}$ in. diameter, centre, and drill through with a No. 30 drill. Scallop out this shallow boss with a round file, so that the barrel part will fit nicely in it ; then, after fitting a $\frac{3}{4}$-in. length of 5/32-in. copper pipe in the end of the barrel, tie the latter into the saddled boss with a piece of thin iron binding-wire, and silver-solder both joints at the one heat. After cleaning up, poke the No. 30 drill into the hole in the spigot, and drill through into the barrel, to complete the thoroughfare.

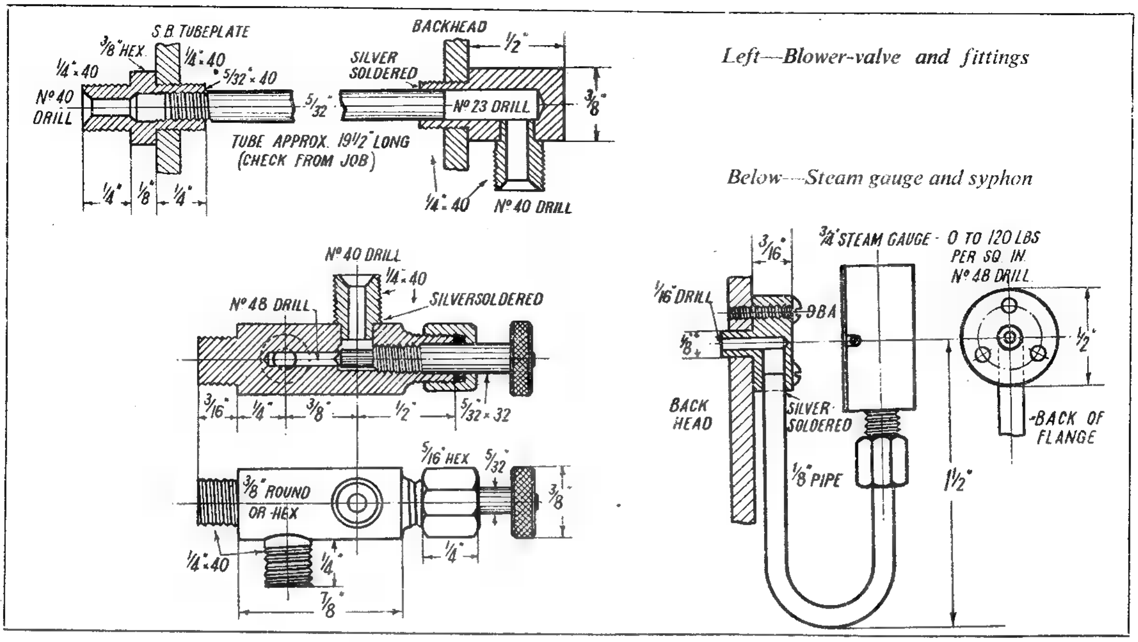
The manifold part is made from $\frac{5}{16}$-in. rod. Chuck in three-jaw, face, centre, and drill to a full $\frac{3}{4}$ in. depth with No. 30 drill. Open out the end with the No. 23 drill to $\frac{1}{8}$ in. depth, and part off at $\frac{15}{16}$ in. from the end ; reverse in chuck, and chamfer the edge slightly. At $\frac{1}{4}$ in. from the blank end, drill a



Details of manifold and turret



Right—Details of the water gauge and operating key



Left—Blower-valve and fittings

Below—Steam gauge and syphon

$\frac{3}{16}$-in. or No. 14 hole right across the centre, cutting through the longitudinal hole. At $\frac{3}{16}$ in. from the drilled end, drill a similar hole, in line with one of the others, but only going halfway through. In all three holes, fit $\frac{1}{4}$ in. × 40 union nipples ; chuck a piece of $\frac{1}{4}$-in. rod, face, centre deeply, drill to $\frac{3}{8}$ in. depth with No. 40 drill, screw $\frac{1}{4}$ in. of the outside with $\frac{1}{4}$ in. × 40 thread, using a die in the tailstock holder, and part off at a full $\frac{5}{16}$ in. from the end. Reverse in chuck, but don't hold the piece tightly enough to damage the threads ; turn down a bare 3/32 in. length, to a tight squeeze fit in the holes in the side of the manifold. Put them in, squeeze the manifold on to the end of the pipe projecting from the turret, and silver-solder the lot. When looking down on the assembly, the side with two unions should be as shown in the plan drawing. Pickle, wash and clean up, then screw the fitting into the tapped bush on top of the wrapper. Set the pipe down slightly as shown.

Water Gauge

The water gauge is of the "standard" pattern which I have found fully reliable over the last 20 years or so, and I recommend it in preference to any fancy pattern. The gland nuts are fully accessible, and the blowdown valve is in such a position that you can get at it, and operate it, without the least risk of burning your fingers on a hot backhead. I can just imagine the flow of good honest railroad Esperanto coming from a driver who burnt his fingers on the backhead, when trying to operate a horizontal wheel right underneath the column, and within about $\frac{1}{2}$ in. of one of the hottest plates outside the boiler !

For the top fitting, part off a $\frac{1}{2}$ in. length of $\frac{5}{16}$-in. rod ; chuck in three-jaw, centre, drill through with No. 12 or 11 drill (easy fit for a piece of $\frac{3}{16}$-in. glass tube) and tap the end 7/32 in. × 40. Slightly countersink, and skim the end true. Reverse in chuck, and put a few $\frac{5}{16}$ in. × 32 threads on the other end. Drill a No. 14 hole at 9/32 in. from the threaded end. Chuck a bit of $\frac{3}{8}$-in. round rod, face, centre, drill down about $\frac{3}{4}$ in. depth with No. 30 drill, turn down $\frac{1}{4}$ in. of the end to $\frac{1}{4}$ in. diameter, and screw $\frac{1}{4}$ in. × 40. Part off at $\frac{7}{16}$ in. from the shoulder. Rechuck in a $\frac{1}{4}$ in. × 40 tapped bush held in three-jaw ; turn to profile shown—exact shape doesn't matter—and turn down $\frac{1}{16}$ in. of the end to a tight fit in the hole in the side of the other part just made. Squeeze it in, making sure the two parts are at right-angles.

For the bottom fitting, chuck the $\frac{3}{8}$-in. rod again, and turn and screw a $\frac{1}{4}$ in. × 40 spigot as before. Centre, and drill to $\frac{3}{4}$ in. depth with No. 30 drill. Part off at $1\frac{1}{16}$ in. from the shoulder. Rechuck in a tapped bush ; centre, drill No. 48 until the drill breaks into the No. 30 hole, open out and bottom to $\frac{7}{16}$ in. depth with No. 30 drill and $\frac{1}{8}$-in. D-bit, and tap 5/32 in. × 32. Reduce the end to the shape shown to make it look pretty. At $\frac{3}{8}$ in. from the shoulder, drill a $\frac{3}{16}$-in. or No. 14 hole into the longitudinal hole, and at $\frac{3}{8}$ in. farther along, drill another, but note—*this latter hole must be at the approximate angle indicated by the gauge blowdown pipe connection shown in the drawing of the backhead complete.* Fit a 7/32-in. × 40 union nipple in it, made as described above. Fit a screwed nipple in the other hole also ; but instead of a plain countersink, run into it, for about $\frac{1}{8}$ in. depth, the same drill used for drilling the upper fitting, so that the glass can seat home in the recess, as shown in the section of the gauge.

Silver-solder all the joints at one fell swoop ; pickle, wash off, and clean up. Make two gland nuts from $\frac{3}{8}$-in. hexagon rod ; I've given instructions for that job so many times, I guess most readers can do it with their eyes shut. Also, make a plug for the top fitting, from $\frac{5}{16}$-in. round rod, filing the head square or hexagon, just as you fancy. The valve pin can be made from 5/32-in. rustless steel, nickel-bronze, or phosphor-bronze. Chuck in three-jaw, and turn down $\frac{3}{16}$ in. length to 7/64 in. diameter, forming a point on the end. I never bother to set over my top slide for these jobs, forming the point with the chamfering tool in the four-station turret,

and finishing by the simple means of sweeping a very smooth file, held at an angle, across the cone as the lathe runs at full speed. Screw 5/16-in. of the follow-up part with 5/32 in. × 32 thread, part off at 13/16 in. from the point, slightly round off the end, and fit a cross handle made from 15-gauge spoke wire squeezed into a No. 47 cross-hole.

How to Erect the Water Gauge

At 7/16 in. to the right of the centre-line of the backhead, draw a vertical line about 2½ in. long. At ¼ in. from the top, on this line, drill a ⅛-in. pilot hole, open to 7/32 in. and tap ¼ in. × 40, for the upper gauge fitting. At 1¾ in. below, the position of the lower fitting, the backhead slopes ; so before drilling and tapping, a wedge-shaped boss should be fitted as shown, so as to give the shoulder of the lower fitting a vertical surface to butt against. It is easily made ; just file the end of a piece of ⅜-in. round rod to such an angle that when held against the backhead, the rod is horizontal. Then chuck the rod in three-jaw, and part off the slice, leaving the thinnest edge about 1/32 in. thick. This is temporarily attached to the backhead with a 1/16-in. screw, so that its centre is exactly in line with the centre of the upper hole, and 1¾ in. below it. Solder it in place, which can be done by putting a spot of Baker's or other soldering fluid around it, laying a bead of solder alongside, and blowing direct on it until the solder melts. The local heat will do the job easily ; I often use my oxy-acetylene blowpipe for small soldering jobs such as this. Alternatively, paint over the contact surfaces with the soldering composition called "Fryolux," and heat as before ; that will do the job. Wash off all traces of the flux, then drill and tap the centre of the boss, ¼ in. × 40. Make sure that drill and tap go in dead square.

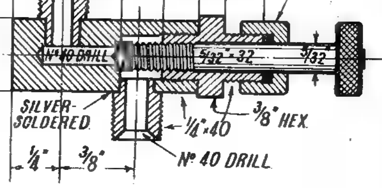
Screw the top and bottom fittings of the gauge into the backhead, lining up by the simple method of dropping the drill through the top fitting, into the bottom one. It should fall into the recess without any coaxing ; if it doesn't, adjust fittings until it does. If fittings go around too far, washers of brass or copper foil may be placed between shoulders and backhead ; if not far enough, a little "Sunny Jim" may be used, but certainly not enough to risk any stripped threads. Anoint the threads with plumbers' jointing before screwing home.

To cut perfect packing rings, put a piece of 3/16-in. rod in three-jaw, slide an inch of rubber tube over it, and try one of the nuts on. If the nut won't go over the rubber, apply a piece of fine glasspaper to the rubber, running the lathe fast, until the nut just goes over the rubber. Then apply the edge of a discarded safety-razor blade to the rubber at about 3/32 in. intervals. Push the rubber off the rod, and there are your rings. Wet the blade before applying to the rubber.

Cut a piece of 3/16-in. glass tube, not less than 1/32 in. thick, to a length of 1⅝ in. ; just nick with a file and snap it with your fingers. No need to grind off the end, though a correspondent in the glass trade told me that gauge glasses can be toughened by heating very slowly and letting them cool slowly. Put it down the top fitting, and put a ring on it, wetting both glass and ring ; then the two nuts, back to back, and another wet ring. Let the glass fall into the bottom socket, push the nuts up and down respectively (they will take the rings with them) and screw them up very little more than finger-tight. Put in the top cap, and the valve pin, and Bob's your uncle once more, as far as that job is concerned. The blowdown pipe is fitted after erecting the boiler.

An Ideal Gauge

This gauge will show a steady clear reading, no special tools are needed to replace a glass accidentally broken (they don't burst of their own accord, in my experience) and you don't burn your fingers when blowing it down. In fact, you needn't put your hand anywhere near it, if desired not to do so. Cut a length of ¼-in. rod, and drill an 11/64-in. blind hole in the end ; or use a piece of tube, making either what length you fancy. Cut a cross-nick big enough to engage the handle on the valve pin ; fit a cross handle (or a wheel, if you like) on the other end, and by slipping the slot over the handle of the valve pin, the gauge can be blown down from the back of the tender, if required.



Injector steam valve

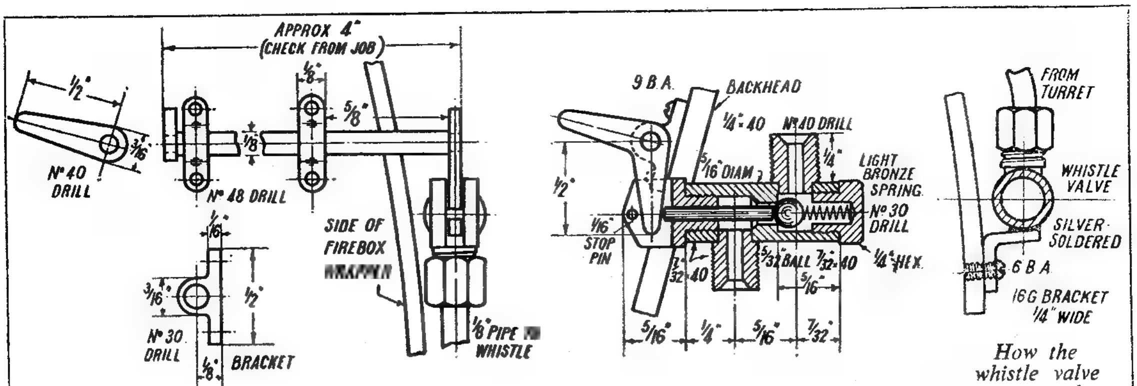
Blower Valve and Fittings

The footplate end of the blower pipe has a fitting which is twin to the wet header of *Invicta's* superheater. Chuck a piece of ⅜-in. round rod, and face the end, centring and drilling No. 23 to a depth of ⅝ in. Turn down ¼ in. of the outside to ¼ in. diameter, and screw ¼ in. × 40. Part off at ½ in. from the shoulder. Halfway along, drill a 3/16-in. or No. 14 hole, and fit a ¼ in. × 40 union screw in it, made as described previously. Fit a 19½ in. length of 5/32-in. × 22-gauge (not thinner) copper pipe in the end, and silver-solder both joints. Drill and tap a ¼-in. × 40 hole in the backhead, at the point indicated in the general arrangement of fittings, and screw in the elbow, guiding the loose end to the hole in the smokebox tubeplate, by a piece of stiff wire, as described for *Tich* and other engines in these serials. The pipe should have ¼ in. of 5/32-in. × 40 thread on the end.

For the thoroughfare nipple, chuck a piece of ⅜-in. hexagon rod in three-jaw ; face, centre deeply, and drill down No. 40 for ⅜ in. depth. Turn down ¼ in. of the outside, to ¼ in. diameter, and screw ¼ in. × 40. Part off at ⅝ in. from the end, re-chuck in a tapped bush, repeat turning and screwing operations, open the hole to ⅜ in. depth with No. 30 drill, and tap 5/32 in. × 40. Put a smear of plumbers' jointing on the threads, and screw home as shown in sectional illustration.

To make the blower valve, chuck a piece of ⅜-in. round or hexagon rod in three-jaw. Face the end, centre, drill down to 1 in. depth with No. 48 drill, open out and bottom to a bare ⅝ in. depth with No. 30 drill and ⅛-in. D-bit, tap 5/16 in. × 32, and open out ⅛ in. of the end with No. 21 drill, to clear the spindle. Part off at 1 5/16 in. from the end. Reverse in chuck, turn down ¼ in. of the blank end to ¼ in. diameter, and screw ¼ in. × 40. At ¼ in. from the shoulder, drill a No. 14 or 3/16-in. hole into the longitudinal hole ; at ⅜ in. farther along, and at right-angles to the first, drill another. Fit a ¼-in. × 40 union nipple into each, same as fitted to manifold, and silver-solder them both.

Make a valve pin like the one in the water gauge, but a full 1 in. long ; file a square on the end, and fit a hand wheel turned from ⅜-in. rod. Dural makes dinky little hand wheels. The gland nut is made in the same way as a union nut ; pack with a few strands of graphited yarn, and assemble valve as shown. Drill a 7/32-in. hole in the boiler



How the whistle valve is erected

Whistle valve and operating gear
(See next instalment)

backhead at the position indicated in the view of the footplate fittings; this is approximately 1 in. from the left-hand side, and 3/8 in. below the regulator handle. Tap 1/4 in. × 40, and screw the blower valve in, so that the union nipple nearest the backhead is horizontal, and the other vertical. The connecting pipes need not be fitted until after the boiler is erected.

If preferred, the blower valve can be made same as *Tich* or *Invicta*, and fitted direct on the end of the blower pipe which goes through the boiler, which makes it more accessible, and dispenses with one pipe. It differs from the position of the blower on the full-size job, but I shall do it thus on my own engine, all the same for that, as I am too big to ride on the footplate, and like to have the handles where I can reach them easily from the driving car behind the tender.

Steam Gauge

A 3/4-in. steam pressure gauge reading to 120 lb. is fitted exactly the same as I have just described for *Invicta*, except that the flange is 1/2 in. diameter, and fixed with 9-B.A. screws; so we needn't waste time going into details. You can [illegible] where to put it by looking at the illustration showing the fully-adorned backhead.

Injector Steam Valve

This valve is slightly different from my usual specification, the object being to make it quick-acting. In the ordinary "one-piece" type, if the pin recess is drilled too deeply, as it often is, it needs five or six turns of the wheel to fully uncover the entrance to the way out. (I *love* splitting infinitives!) By making the gland section separate, [illegible] on full-sized globe and angle valves, there is enough space around the valve pin to give ample opening with one turn of the wheel.

Chuck a piece of 3/8-in. round or hexagon-rod in three-jaw; face, centre, and drill down to 13/16 in. depth with No. 40 drill. Open out and bottom to 3/8 in. depth with 7/32-in. drill and D-bit, and tap 1/4 in. × 40. Part off at 15/16 in. from the end. At 1/4 in. from the blank end, drill a No. 14 or 3/16-in. hole; and another, 3/8 in. farther along, and exactly opposite, both holes breaking into the central one. Mind the valve seat! Fit a 1/4-in. × 40 union nipple into each, and silver-solder both. Chuck a bit of 3/8-in. hexagon rod, face, centre, drill down about 3/8 in. depth with No. 30 drill, and tap 5/32 in. × 32 for about half the depth. Turn down 3/16 in. of the outside to 1/4 in. diameter, and screw 1/4 in. × 40. Part off at a full 1/2 in. from the end. Reverse in chuck, and ditto repeato turning and screwing; open the bore with No. 21 drill as far as the tapped part. Screw the tapped end into the body of the valve, and fit a valve pin with the cone turned direct on the end of the screw, as shown; no reduction in diameter is necessary. The gland nut and hand wheel are the same as for blower valve. Next stage, whistle valve and operating gear.

FOR THE BOOKSHELF

Burrell "Two Seven O Four," by A. T. Phoenix. 16 pages. Price 2s. by post from the Author, 15-17, The Square, Pike Lane, Thetford.

This booklet contains a number of amusing anecdotes concerning a fine Burrell single-crank compound steam road locomotive and the personnel who had charge of her during a certain period. Written in the Norfolk vernacular, the stories make entertaining reading that should not be missed by any lover of the steam road locomotive.

Famous British Engineers. By Leslie Halward. (London: Phoenix House Ltd.). 192 pages, size 5½ in. × 8½ in. 22 illustrations on art-paper inserts. Price 12s. 6d.

This excellent book is intended for "boys of all ages"; it tells, in simple but stirring manner, the stories of seven of Britain's pioneers in engineering, whose names became, and still are, famous the world over. They are: James Brindley, John Smeaton, James Watt, Thomas Telford, John Rennie, George Stephenson and James Nasmyth. The author presents each of his heroes in plain, straightforward fashion, without any rhetorical extravagance, and yet in a manner calculated to fire the imagination and stir the enthusiasm of any reader. It is much to the benefit of the younger generation that books of this kind can still be written; conditions today are vastly different from what they were at the time when the great men mentioned were working out their epic engineering schemes, and the stories cannot be told too often

STORAGE SPACE

By A. M. Tucker

PLENTY of storage space is a great help in keeping the workshop tidy, especially if space is restricted. In the writer's case, the workshop occupies part of a bedroom, and is at present only usable in the early evening and at the weekend. During the week everything needing repair—toys, household articles, etc.—finds it way on to the bench, and this litter is augmented by tools used during the evening and dumped on the bench so as not to disturb the seven-year-old occupant of the bedroom. Consequently, by the weekend, there is no room to put anything down on the bench, and a space has to be cleared before any work can be done. When a workshop gets into this state, tools seem to develop remarkable powers

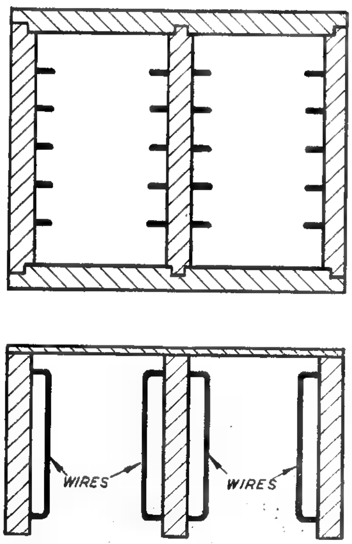


Fig. 1. *A rack for twelve tins*

of self-concealment, and most of one's time is spent looking for the screwdriver or spanner one has just put down. Some small component is placed on top of a tin sticking up like a rock out of the maelstrom, under the impression that it will be easy to find again. This is a fatal mistake: the writer has proved by bitter experience that the tops of tins are completely overlooked when searching for anything.

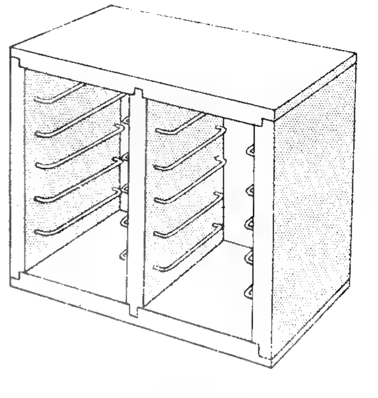
If you are a naturally tidy individual, this state of affairs will probably not occur, but for those of us who are constitutionally incapable of putting a tool back in its proper place as soon as they have finished using it, probably the best plan is to have a tray on the bench near to one's hand into which tools can be placed as one puts them down. When the tray becomes too crowded, one breaks off for a putting-away session. Similarly, a box can be provided into which the family can put all items for repair.

Tool Storage

Plenty of drawers help the problem of tool storage, but two shallow drawers are better than one deep one. A drawer about 2 in. deep is very useful for files, especially if it is divided lengthways by small strips to prevent the files rubbing against one another. A second drawer of the same depth is handy for small tools. Those in frequent use can be accommodated on a rack at the back of the bench. Old pipe racks, or those racks used in offices to hold rubber stamps, are suitable, in addition to boards fitted with Terry spring clips.

A useful nest of drawers for small articles can be made from 2-oz. tobacco tins, either with or without their lids. For very small articles, such as miniature rivets, the tin may be divided into several compartments by soldering in tinplate partitions. Solder a large-headed nail, such as a hobnail or upholstery nail, into one end of each tin to act as a handle, and label either with small paper labels, covered and kept in place by transparent adhesive tape; or by painting the end of the tin with matt white paint in order to provide a surface which can be written upon.

A rack for about a dozen tins can be made very simply as follows: Cut three pieces of wood about $\frac{3}{4}$ in. thick, the same width as the length of the tins, and of suitable length according to the number of tins to be used, and two more pieces for top and bottom about $2\frac{1}{2}$ in. longer than twice the width of a tin. Assemble as shown in Fig. 1. The joints may be halved, as shown, dovetailed, mitred or plain, according to taste. Fit a plywood or metal back. The supports for the tins are



made from pieces of stiff wire fitted (before assembly) into undersize holes drilled in the side and centre-pieces.

Storage Boxes

For taps and dies, these are conveniently made from pieces of thick plywood. The round recesses for dies can be made with a suitable carpenter's bit, or an adjustable bit, if available. If not, a cutter can be made by filing teeth on the end of a piece of tube of suitable diameter—even a piece of metal curtain rod can be used. Choose tubing slightly smaller than the required hole and set the teeth alternately inwards and outwards. This type of cutter can only be used in the lathe or drilling machine, with the plywood clamped in position, but it will do the job even if crudely made, and does not need to be hardened for the small number of holes required. The centre-piece left in the wood can be cut out with a small chisel, using the layers of plywood as a guide in order to cut

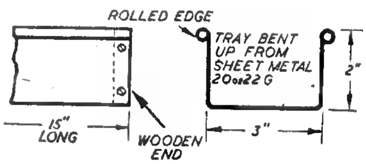


Fig. 2. *Tray for rod, strip, etc.*

each hole the same depth. If a carpenter's bit has been used, the bottom of the hole may need finishing off with a chisel, and the small hole left in the centre should be filled with plastic wood. Cut a small rebate on one or both sides of the hole so that the die can easily be lifted out when required.

The recesses for the taps may be

(*Continued on page* 311)

An automatic feed for the shaper

By David Williams

I HAVE for some time been using an automatic traversing feed fitted to my Adept shaper, similar to the one described in THE MODEL ENGINEER some time ago, but have often felt the need for an auto-feed which would move the saddle in both directions. I decided that no alterations to the basic construction of the shaper would be made, and no holes bored in the machine, so the attachment described here was evolved.

The Operating Principle

On the backward stroke the ram pushes the toggle back, which after the initial movement rides under the left-hand vee of the ram. This movement is transmitted via the square hole in the toggle to the square shaft, to which, at one end, is attached a slotted crank. This in turn is connected to the auto-feed by a link. A spring strong enough to push the ratchet wheel round when traversing from left to right, is fitted behind the slotted crank, one end being anchored to the pedestal, the other end to the crank.

Construction—The Ratchet Wheel

A 35-tooth gear wheel I had by me was set to run truly in the four-jaw, and the 1 in. hole was bored to a nice push fit on the boss of the handwheel. The wheel was then reduced in thickness by $\frac{1}{8}$ in. to leave a boss $1\frac{1}{4}$ in. dia. The keyway was cut by using a square bit in a Nulok boring tool on its side in the toolpost, racking the saddle back and forth and feeding outwards a few thou. at a time until the correct depth was reached. The wheel was next mounted on a stub mandrel, and a corresponding boss turned on the opposite face. A matching keyway was the cut in the handwheel boss.

Side Plates

Two pieces of mild-steel plate were cut roughly to shape and size, then sweated together, marked out, and all holes drilled and bored. The hole marked " X " was drilled tapping size for 2 B.A., and after separating one plate was tapped 2 B.A., the other opened out to $\frac{3}{16}$ in.

Spacers

These were turned and drilled 6 B.A. clearance. The finished size depends on the original thickness of the gear wheel, 1/64 in. oversize is about right. The wheel was now assembled between the plates and bolted up.

The Pawls.

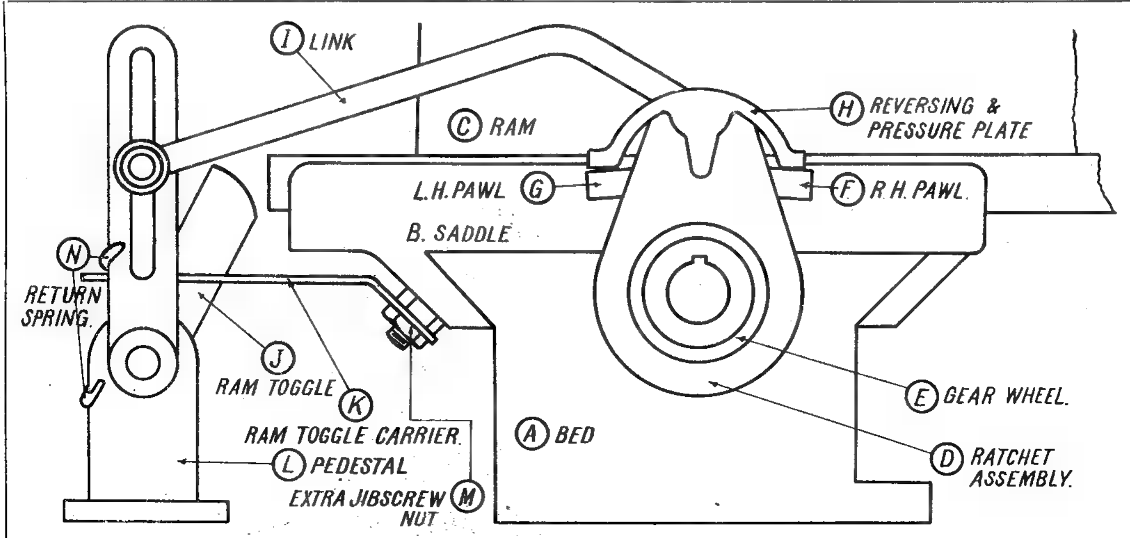
These again were made from mild-steel, and call for little comment, except that when assembled the points must clear each other as they are lifted in and out of engagement. The springs were made from one strand of Bowden brake-cable.

Reversing Pressure Plate. (H)

This was cut from 3/32 in. mild-steel plate. The two ends which were bent 90 deg. in the vice were left well oversize in depth to allow fitting by trial and error, until when the plate was in an horizontal position the ends bearing on the pawls lifted them clear of the ratchet wheel. This is neutral and allows the cross feed handwheel to be turned in either direction. When the plate is rotated on its bolt to the rear of the shaper, the rear pawl is lifted out of engagement so that the front pawl turns the ratchet wheel anti-clockwise, and vice versa. The pointed finger is bent inwards, so that when the nut is tightened it bears on the side plate, and stays in position by friction. This works quite well and no indent is needed.

Link (I)

This is a piece of mild-steel $\frac{1}{4}$ in. dia., and apart from polishing, and squaring the ends, no machining was required.

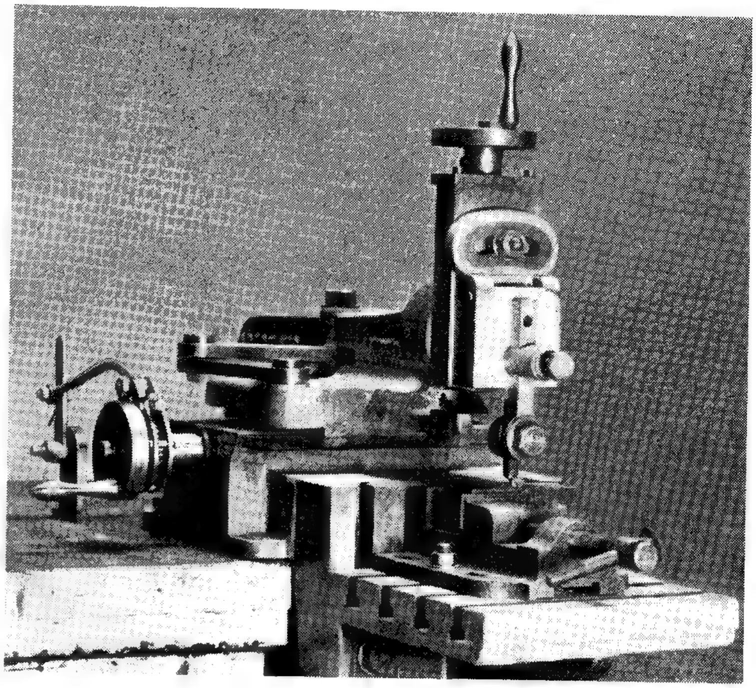


General arrangement ; handwheel omitted for clarity. (Diagram only)

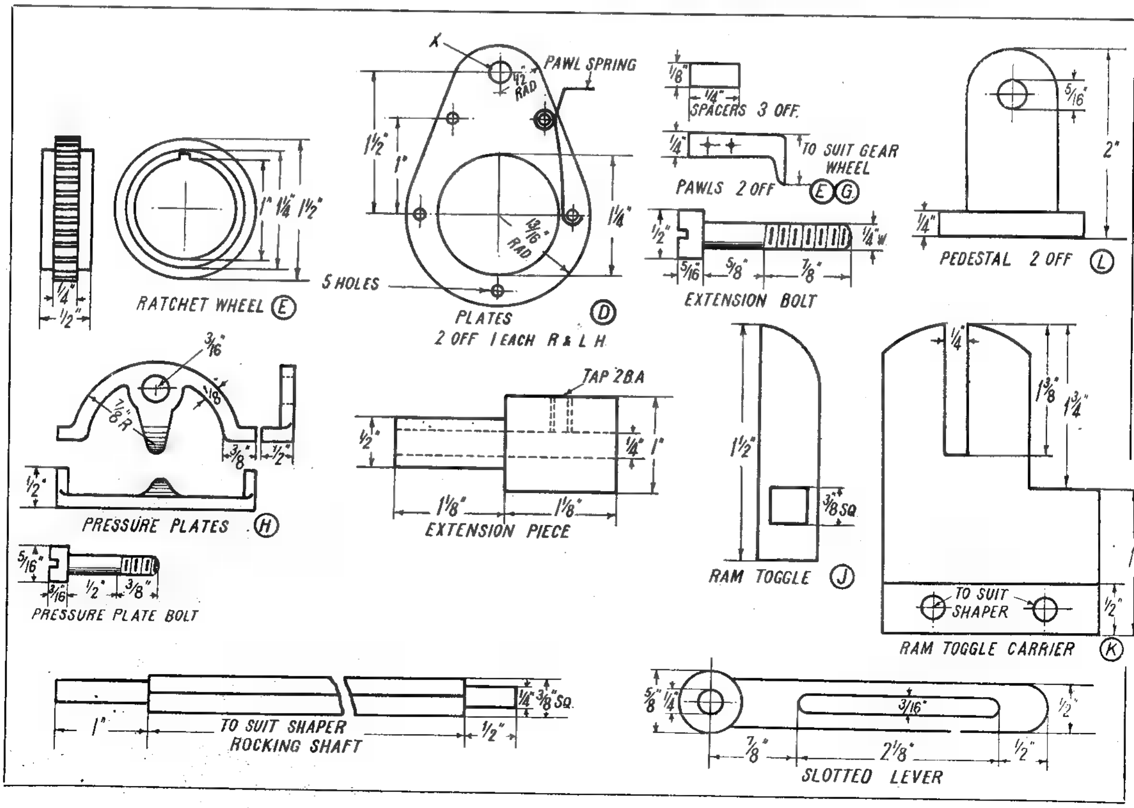
The two eyes were turned, drilled and reamed, then silver-soldered in position. The large one which runs on a die-bolt in the slotted arm, has a bronze bush turned to a nice running fit, drilled and reamed $\frac{3}{16}$ in. and left 1/64 in. wider than the eye, so that when the nut on the die-bolt is tightened up it is free to revolve on the die-bolt and in the eye, but is held in the desired position on the slotted arm. The link was then bent to 30 deg. at 2 in. from the small eye to prevent it fouling the rear pawl when in a forward position.

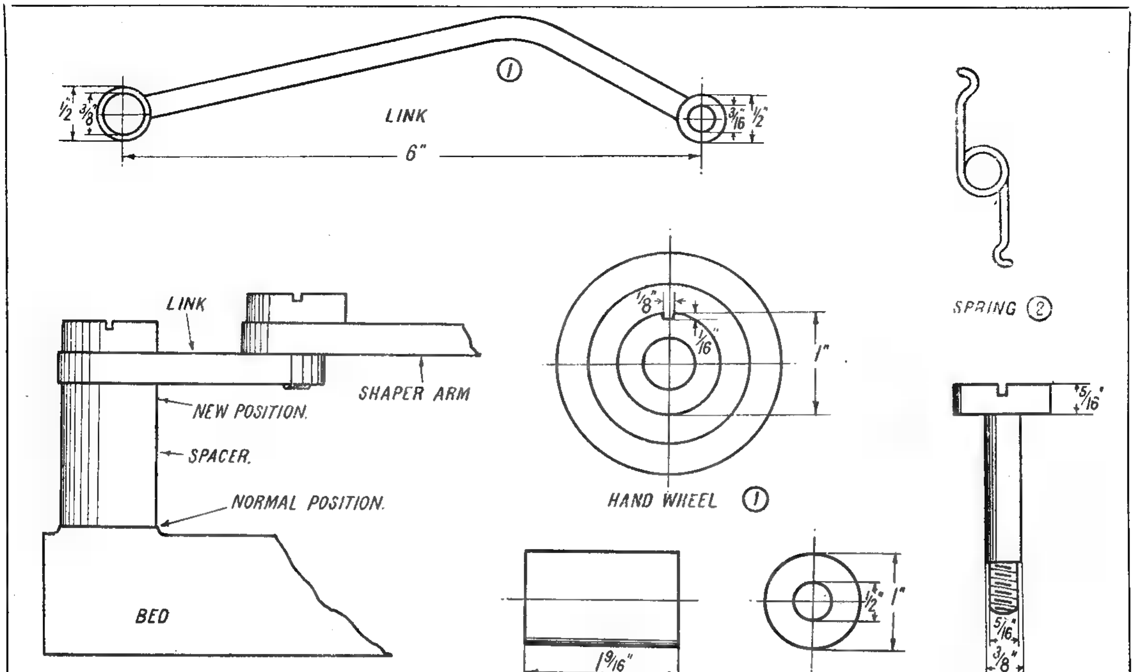
Extension-piece

This is necessary for clearance when saddle is at extreme left and is a straightforward job. The keyway was cut with a Woodruff cutter in the three-jaw chuck, the work held in a machine vice packed to a suitable height on the boring table. A further improvement has been made since the photograph was taken, namely, the spacer (4). This, and the special bolt, were made to the dimensions given, the shaper arm removed from its slot in the ram, and the spacer placed under it, the arm then placed on top of the ram, and the



The automatic feed in operation





New position for shaper arm

bolt reinserted. This works quite smoothly, and gives $\frac{3}{4}$ in. longer stroke at each end, but there is no positive stop as before.

The Slotted Arm

This was cut from a piece of mild-steel $\frac{1}{2}$ in. × $\frac{1}{8}$ in. The slot which enables the amount of feed to be adjusted, was formed by drilling two $\frac{3}{16}$ in. holes at $2\frac{1}{8}$ in. apart, the surplus metal removed with an Abrafile ; a touch with a file cleaned it up to the final measurement. Here it may be pointed out that the the return spring is rather difficult to make, and unless a commercially-made one is available, the length of the arm could be increased at the end opposite the slot, by $1\frac{1}{2}$ in., to enable a suitable expansion spring to be fixed in a hole drilled at the extreme lower end, the other end of the spring anchored to the bench at the rear of the shaper to a bolt in a tapped hole in a piece of mild-steel angle, which is in turn screwed to the bench, resulting in a means of tension adjustment. The boss was turned from mild-steel, silver-soldered in position, and tapped to take a 2-B.A. set-screw.

Pedestals, Ram-toggle Arm and Shaft

The pedestals were cut from $\frac{1}{4}$-in. mild-steel with a hacksaw and filed to shape. The $\frac{3}{8}$ in. square shaft was set to run true in the four-jaw, and the ends turned down to $\frac{1}{4}$ in. for the required length. The toggle arm was made from hard brass, the square hole being formed by drilling and filing.

Toggle Arm Carrier

One-sixteenth-inch mild-steel plate was used for this, and made to fit the second and third saddle jib-screws. These two screws were removed and replaced by two longer ones, thus enabling fine adjustment to the slides and then locked with the original locking-nuts. The carrier was then placed in position, and two additional nuts screwed on to the projecting ends of the elongated jib-screws, and screwed home without disturbing the adjustment of the slide.

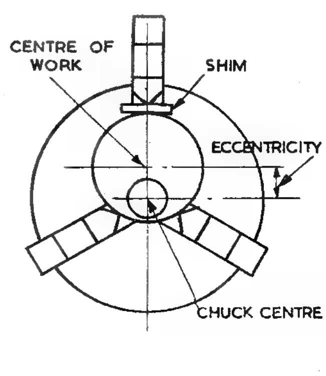
Assembly and Operation

This completed all the parts which were assembled and adjustments made. When tried out, the auto-feed gave good results in both directions using coarse and fine feeds, and has continued to operate very satisfactorily ever since.

TURNING ECCENTRICS

ONE of the quickest ways of chucking work off centre in the lathe for eccentric turning is to remove the No. 3 jaw of the chuck. Then turn the jaw-actuating scroll thread in the chuck the proper number of turns to secure the offset you wish, and replace the jaw. Since this will rarely give the exact amount of eccentricity desired, engage the jaw at the nearest oversize point and use a shim between this jaw and the work for the exact setting.

—F. STRASSER.



READERS' LETTERS

[redacted] Letters of general interest [redacted] all subjects relating to model engineering [redacted] welcomed. [redacted] nom-de-plume may be used [redacted] desired, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

WOODEN MILL GEARING

DEAR SIR,—With reference to the query of J.H.M., of Buxton, on the renovation of [redacted] water mill (January 29th, 1953) and your reply; I should most strongly recommend that the wooden teeth be retained and *not* substituted by cast-iron gearing.

If some of the teeth require renewing, he should use apple wood, and if the job is carefully done, he will find it gives many years' satisfactory service.

Some 30 years ago, I renewed a number of teeth on the main horizontal wheel driving the vertical (wood !) shaft of an ancient water mill not very far from Buxton, the wheel itself was cast-iron, with inserted apple wood teeth, socketed and wedged into slots in the cast-iron wheel rim, and I believe they are still standing up and laughing! In earlier years I "toothed" quite a number of this type of wheel, both spur and bevel, and properly done, they give many years of satisfactory and (comparatively) silent service.

I imagine this art of fitting wooden teeth is very nearly a lost one now, but 50 years ago it was well known and largely practised.

Yours faithfully,
Rustington. K. N. HARRIS.

REAR TOOLPOSTS

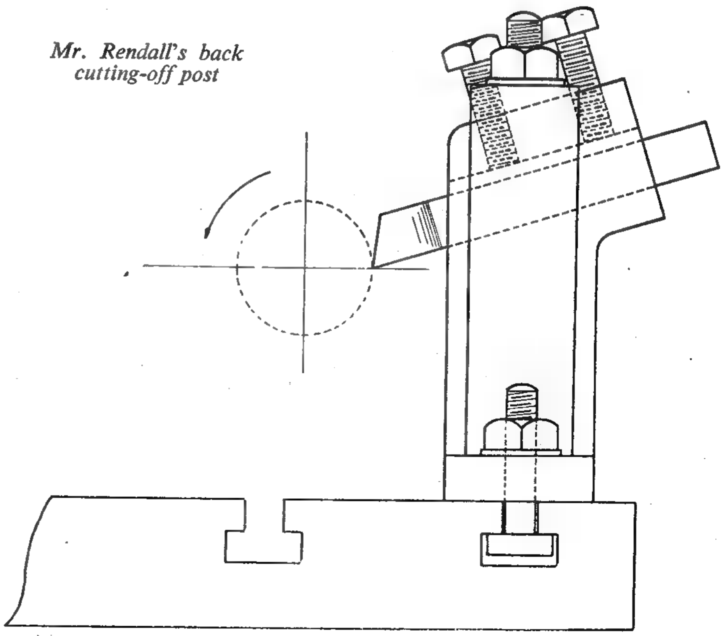
DEAR SIR,—There were many points in the description of the new Myford lathe, illustrated in THE MODEL ENGNIEER for January 15th, that caught my attention. First and foremost was the rear toolpost, and I note that, like most others that I have seen, the parting tool is held horizontally. What sort of a parting tool do Messrs. Myford recommend? I have a 4 in. Super-Exe lathe, and my experience is that [redacted] parting tool must have top rake to cut freely. All the parting tools, that I have ever been able to buy, have flat tops, i.e., no top rake, and grinding top rake on such tools, partly weakens them and shortens the length of blade available for cutting. I have seen a heavy industrial lathe parting off slices of steel with [redacted] no-top-rake parting tool, but it seems rather unfair to expect a small lathe to do this sort of thing; or do Messrs. Myford recommend [redacted] no-rake tool? I submit for criticism a sketch of a back cutting-off post I have designed for my Exe, in which the parting-tool is held at an angle of 16 deg. to give top rake, so that a flat-topped tool may be used. I have never seen a rear toolpost having this feature, and feel that there must be some snag in it, otherwise [redacted] design that appears to have so many good points would be more commonly fitted.

I notice that the Myford mandrel design is practically the same as the Exe, except that it has double ball-bearings at the back in place of the single set in the Exe. I am sure that this is by far the most satisfactory form of mandrel, where reasonable cost of production has to be studied as well as perfection. I have had 15 years of satisfactory service out of my lathe, and it has only had a little take-up once. The Myford Co. have a good thing here.

Finally, at last a clutch for an electric-drive lathe. What an improvement! After the war I bought a 5 in. electrically-driven lathe, but I soon developed a not unfounded loathing for switching the motor on and off, for every little test and examination. Well, that motor is (*pro tem*) out of action, and I have had to return to the Exe; my first impression after returning to it, is what a perfect tool the foot-driven lathe can be. I remembered, too, a workshop owned by a friend before the war, in which the chief weapons were [redacted] Zyto lathe, driven by a ¾ h.p. Gardner gas engine through a shifting belt. That gas engine ran like a steam engine; although it was in a crowded urban district, there was never a word of complaint from the neighbours, and that shifting belt was a far nicer control than switching on and off. Well, these old gas engines have gone now, and I can't say much for the little air-cooled engines that have partly replaced them. A friend proudly demonstrated to me a "rattler" he had bought, and I imagine it would cause a riot among the neighbours.

Yours faithfully,
Swanage. H. E. RENDALL.

Mr. Rendall's back cutting-off post



FLUORESCENT LIGHTING

DEAR SIR,—In a recent article on the above subject by M. E. D. Isle, the writer states that fluorescent lights, having a flicker corresponding to the frequency of the supply are undesirable for use over moving machinery.

This, of course, is true, but his remedy is not very practical for the average model maker. Few model engineers have access to a three-phase supply, and in any case this type of supply is dangerous for amateurs to meddle with.

The answer to this question is in the use of a twin tube circuit, which, having the P.F. condenser in series with one tube as shown in the diagram, makes the tubes work at a phase displacement of 90 deg., which obviates the possibility of stroboscopic effect.

For lighting over the average small lathe, the 40 watt 4 ft. tube is quite adequate, and a twin tube unit using this type of tube will be more suitable and cheaper, in both initial outlay and running cost.

Yours faithfully,

Erith. H. F. PANKHURST.

DRILL SIZES FOR TAPPING HOLES

DEAR SIR,—Mr. H. G. Sharpe, writing in your issue of February 5th, comments on the confusion existing as to the correct sizes of tapping holes, and goes on to suggest that taps should be made with their shanks the size of the correct tapping drill. This I am afraid, as regards the smaller sizes, say up to 1/8-in. Whitworth or 5 B.A. with which I assume Mr. Sharpe is primarily concerned, is not a practical proposition, for the following reasons.

(1) In the smaller sizes, the shank would be hopelessly weak, for instance a 1/16-in. Whitworth tap would have a stem only 0.046 in. (3/64 in.) diameter and a 10 B.A. one of 0.052 in.

(2) There *is* no single "correct" size of tapping hole for all conditions. For instance, if you are tapping a short "thro" hole in screw-rod quality brass, say 1/8 in. Whitworth, then the drill size usually given for tapping, i.e. No. 40, will be safe If, on the other hand, you are going to tap a long hole in drawn phosphor bronze, gunmetal or mild-steel (or worse still, copper) you will almost inevitably break your tap if you use such a drill, and you will find it necessary to use a No. 37 drill to be reasonably safe (0.006 in. larger than a No. 40). Even this will need considerable care, and constant easing back, removing and cleaning.

The trouble is that with comparatively long-fibre metals, such as those instanced, the tap does not function as a pure cutting tool, but partly as a swaging and forming tool, and it tends to squeeze some of the metal into the female portions of its own threads ; a lubricant, whilst helping the cutting action, has little or no effect on the swaging action, and for this reason, the tapping hole must be larger than the nominal size. Take a bit of mild-steel of good quality, say 1/4 in. to 3/8 in. thick, and drill a hole in it with a No. 37 drill in good condition (if you are doubtful, use a No. 40 first and open out with the No. 37). Carefully tap the hole 1/8-in. Whitworth with taps in good order ; when finished you will find that you cannot get the 37 drill through the tapped hole, the threads having "built-up" and reduced the core diameter.

It is not possible to lay down hard and fast sizes for tapping drills for the smaller ranges of threads to suit all conditions; experience will enable you to estimate pretty accurately what oversize allowance to make for any particular case.

It is not a matter of intuition or some sixth sense; I just don't believe in these things in engineering matters ; what frequently passes for such is really the accumulated and largely subsconscious knowledge stored up over years of experience. Most of us are lucky if we have five senses fully developed, plus a bit of common sense thrown in, without any heaven-sent (and probably illusory) sixth sense.

I suggest to Mr. Sharpe that he should spend a few hours carefully making a series of tappings in various materials (with the tap sizes with which he is chiefly concerned) and make a note of the drill sizes which give him the best results ; I am sure that the time so spent will be amply repaid in expediting future work, to say nothing of the saving in taps.

Yours faithfully,

Rustington. K. N. HARRIS.

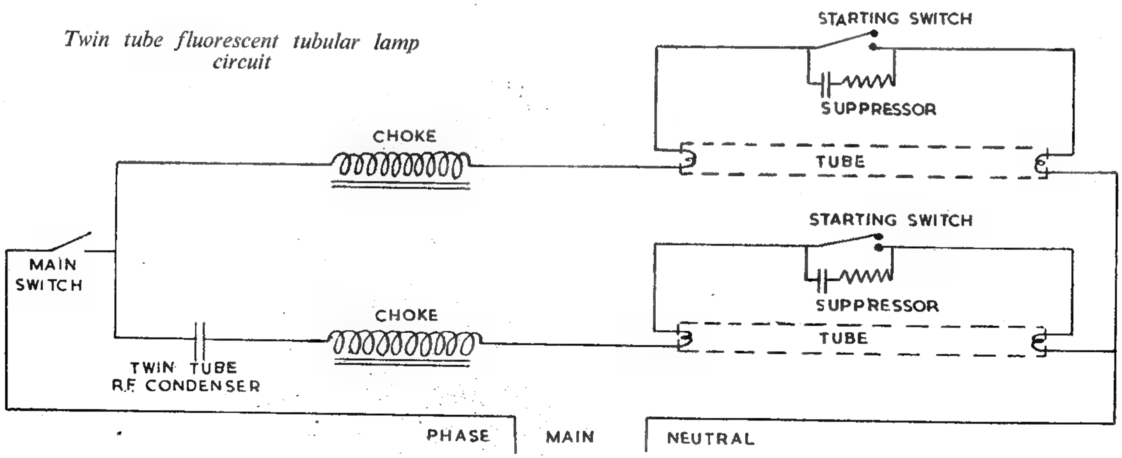
INSERTING SMALL SCREWS

DEAR SIR,—With reference to your recent article on the above subject, much the easiest way to do this is to use a "Varney" screwdriver.

These are used in the motor car repair trade and are made at Sheffield. The screw is held by a spring in the slot and can be released at will. Needless to say I have no interest in the firm.

Yours faithfully,

Watford. O. J. R. BROOKMAN.



Twin tube fluorescent tubular lamp circuit

SURFACE FINISHING

By "Duplex"

It is always interesting to examine competition exhibits with a critical eye for what some might regard as minor and unimportant points of fit and finish. Nevertheless, it is these that often determine real craftsmanship and the overall quality of painstaking workmanship. Experienced workers are well aware of this, and these notes are intended for beginners or those who have started on the way up.

Knurling

How often one sees a fine piece of work quite spoilt by the indifferent finish of the knurled parts ; that is to say, the pattern is not clearly defined, and the diamond-shaped points are blunt instead of being quite sharp. It is not suggested that this need be carried to the length where a war-time factory had a large consignment of terminal nuts rejected because the knurling was not quite perfect. The remark, often heard, that the knurling is very good serves merely to emphasise the poor quality of average knurling, but there is no reason why all knurling should not be above reproach if the tools are right for the job and are properly used.

The knurling wheels themselves should be of the best quality, and those with rolled or roughly-cut teeth are best avoided.

Next, the knurls, if they are to cut a uniform pattern, must run truly on their axle pins. Revolve each knurl on a well-fitting dead centre, with the plunger of the test indicator in contact with the teeth. This simple test will eliminate many knurling wheels.

As considerable pressure is required to impress a knurled pattern on steel, it is better, for the sake of the lathe mandrel bearings, to use a tool like that illustrated in Fig. 1. Here, the pivoted swing-arms ensure that the radial pressure applied is equal in two opposite directions and is not borne by the lathe bearings.

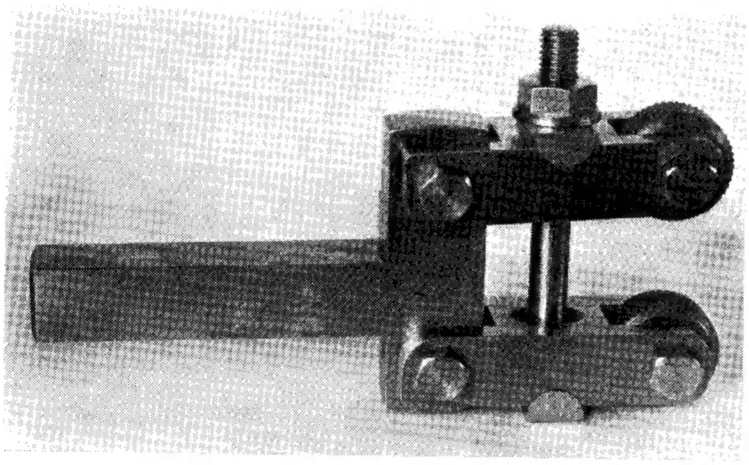


Fig. 1. An improved form of knurling tool

After the work has been turned parallel, the knurls are lightly closed to bear at diametrically opposite points on the work.

Operation

Next, the tool is traversed clear of the work, and the adjusting screw is given from a sixth to a quarter of a turn to close the knurls still further. Start the lathe in backgear, and feed the knurls along the work for about a quarter of their breadth. Stop the lathe and examine the pattern formed ; if this shows that the knurls are out of step, close the wheels a little more while the lathe is running. As the knurling tool obscures all but the back of the work, a better view will be gained by using a handled, dental mirror of the kind obtainable from the tool-merchant. As soon as the pattern is seen to be properly cut, the lathe can be run on the slow, direct speed, and the tool is fed along the work by hand. Light and medium knurling can be cut by a single passage over the work, and this is to be preferred, as there is then less likelihood of rolling chips into the work surface. For the same reason, cutting oil is, perhaps best avoided, as it retains the swarf and does not allow the chips to fall clear. To finish the work, the knurling can be cleaned with a wire brush.

Bolts and Nuts

Fig. 2 (*A*) shows how a neatly fitted bolt should look, but all too often one sees the bolt ends left standing proud as in Fig. 2 (*B*) or, worse still, only some of the nut threads engage the bolt, as in Fig. 2 (*C*). Eyesores such as these are, in some situations, silent witnesses of indifferent craftsmanship and cannot escape the scrutiny of a competition judge.

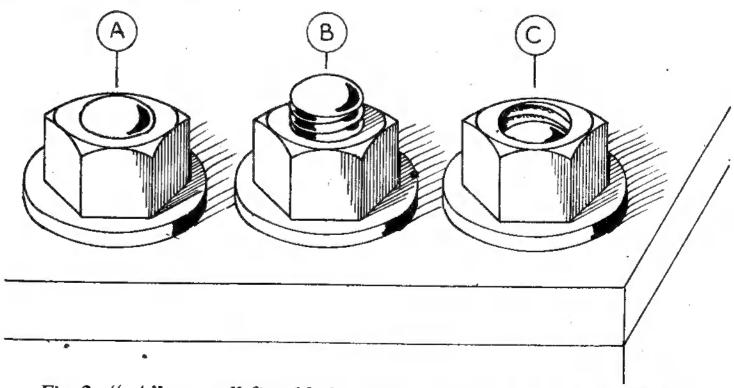


Fig. 2. "A"—a well-fitted bolt ; "B" and "C" show faulty fitting

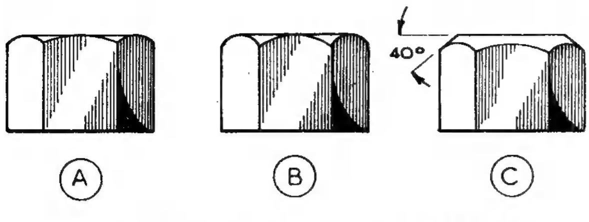


Fig. 3. Nuts with various widths of chamfer

The depth and angle of the chamfer goes a long way in giving a nut a well-finished appearance. Fig. 3 (*A*) shows a nut made rather unsightly by having too narrow a chamfer ; nut (*B*) has the standard depth of chamfer found in an ordinary commercial nut ; but nut (*C*) has the deep chamfer, used in some classes of work, which gives it a lighter appearance and possibly suggests that it has been specially made for the job. The chamfer is usually formed at an angle of 40 deg., but an angle of 30 deg. is sometimes used. The tool illustrated in Fig. 4 will serve well for cutting in the upside-down position in the back toolpost ; this will enable broad chamfers to be machined without chatter.

Screws

If the finished work is to look right, any screw heads appearing on the surface must be properly fitted. The sunk screw head, Fig. 5 (*A*), not only looks unsightly, but dirt and chips collecting in the recess round the head will be difficult to remove. The filister-head screw, shown in Fig. 5 (*B*), is used in instrument work and should be fitted with the base of the curved portion level with the work surface ; Fig. 5(*B*) illustrates the wrong way of fitting the screw. When, as in Fig. 5 (*C*), the screw head stands proud, other parts will be unable to seat properly on the work surface. Moreover, the recess for the screw head is, here, too wide and too shallow, but reducing the length of the head, instead of deepening the recess, will weaken the screw.

Commercial Screws

These usually have a head diameter of a recognised fraction of an inch, to enable a standard counterbore to form the flat seating for the head. The heads of Allen screws are machined to very close limits on diameter, and the manufacturers state that the knurled head of a cap-screw will serve to lock the screw when the recess is counterbored to a close fit.

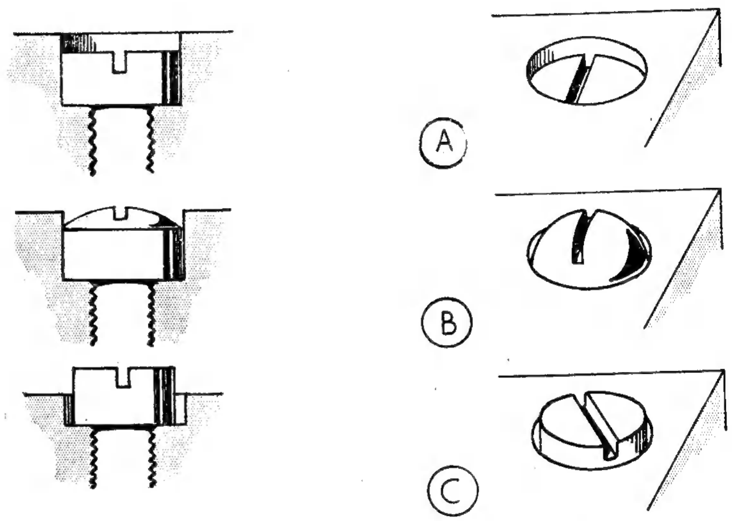


Fig. 5. Showing errors in fitting screw heads

There should be no difficulty in fitting screws flush with the work surface, if the heads are made of uniform depth. When the correct depth of counterboring for the first screw has been found, the depthing stop of the drilling machine is set, and the remaining seatings are then machined to the same depth.

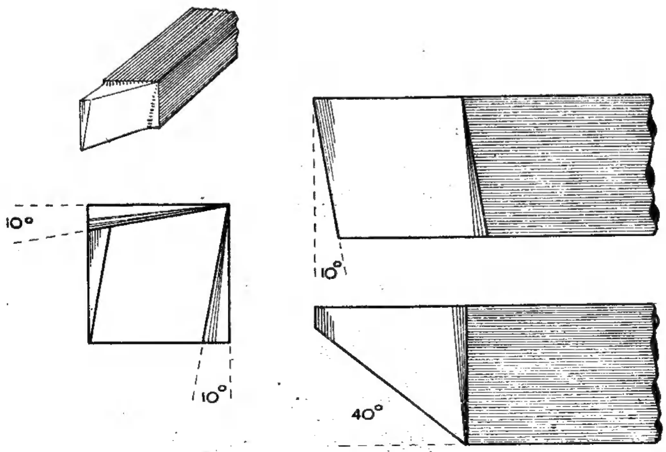


Fig. 4. A standard chamfering tool

Finishing Curved Surfaces

Some workers seem to have difficulty in forming an even, hollow curvature at the junction of two flat surfaces.

The usual way of working is to mark-out the part and then to drill

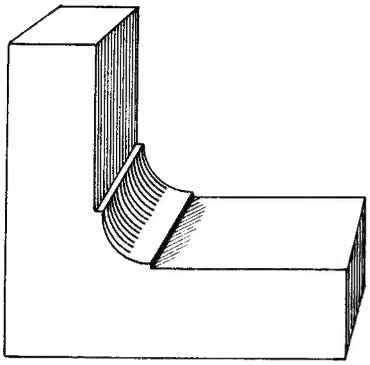


Fig. 6. Forming a curvature to join two flat surfaces

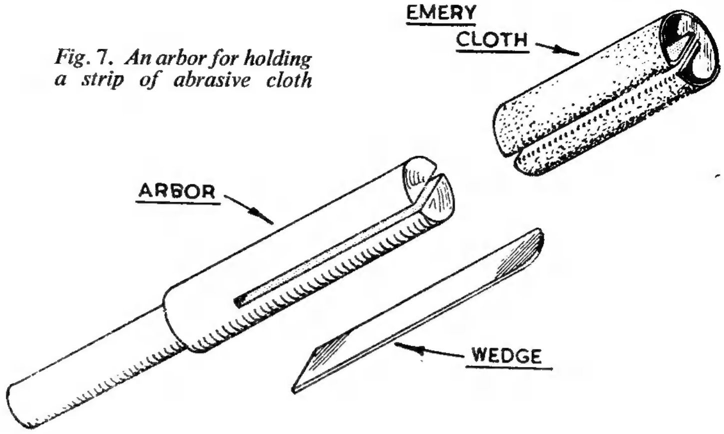


Fig. 7. An arbor for holding a strip of abrasive cloth

a hole to form a radius where the two straight sides meet.

After the work has been filed to shape, it will have the appearance shown in an exaggerated form in Fig. 6. The problem now is to remove the surplus metal so as to leave an even curvature blending with the flat surfaces. The bulk of the metal can be removed with a round file, and an even, well-finished surface will be obtained by using the tool illustrated in Fig. 7.

To make the tool, a length of round rod is slit for an inch or so down the middle so as to retain a strip of abrasive cloth in place. This arbor is gripped in the chuck of the drilling machine, and the cloth is wound on so that it tends to tighten when brought into contact with the work. The cloth is held in place either with a wire binding at the upper end or, as shown in the drawing, both ends are tucked in and then secured with a thin wedge. The work is held flat on the drilling machine table and pressed against the rotating arbor; at the same time, the part is kept moving along the line of the curvature until correctly finished. If oil is applied, the cloth will cut more freely and will be less liable to become loaded with metal dust.

Finish of Flat Surfaces

The appearance of a flat surface can be ruined by the injudicious use of emery-cloth, for in this way the edges of the work are often rounded, and any slightly projecting screw-heads are given an uneven, curved finish. For most work, the appearance of a properly filed flat surface can hardly be improved upon; but, if an emery-treated finish is preferred, the abrasive cloth must be fixed to a flat surface and the rubbing block is then worked in straight lines; on no account must the block be allowed to tip at the edges of the work. It is not usually practicable to try to form a flat surface in this way on stock material. After the surface has been filed or machined flat, light tool marks can be removed by giving a few, well-controlled strokes with the rubbing block and, at the same time, plenty of oil should be used to avoid forming an unsightly, glazed finish.

STORAGE SPACE

(*Continued from page* 303)

cut with end-mills of suitable size, or even with ordinary twist drills. The slot cut by the latter may need truing up a little at the ends, and the bottom of the slot will not, of course, be flat, but provided care is taken with the small sizes, this method is very effective, and has the advantage of a far greater choice of size than is likely to be available in end-mills. The less the drill projects from the chuck the better, of course, especially in the smaller sizes. The slots can be cut with a drilling machine if an adjustable fence can be provided to guide the piece of plywood while the slot is being cut. If the job is done on the lathe, a piece of wood screwed on the back of the plywood will enable it to be held in a vice on the vertical slide. Cut the slot to a slightly greater depth for a short distance at one end; the tap can then easily be taken out by pressing on it at that end.

The finished boxes may be fitted with lids, or they may be stored in a fitting similar to that described earlier (for holding tobacco tins), or slides to accommodate them can be fitted underneath convenient shelves.

National Dried Milk tins are very useful for storing small pieces of metal, scrap brass, etc. One way of marking the tins for easy recognition is to paint them in various appropriate colours; yellow for brass, orange for bronze, red for copper, and so on.

Container for Scrap Pieces

Finally, here is a container for pieces of rod or strip up to about 1 ft. in length. It consists simply of a piece of sheet metal bent as shown in Fig. 2, with wooden ends fixed in with screws. If the edges of the metal sheet are bent over as shown, the containers can be stored in slides below shelves, otherwise they can rest on a skeleton shelf consisting of a couple of bars. The dimensions can be varied to suit individual requirements.

When you have provided all this extra storage space, you will probably find that all that useful junk and valuable material which keeps on accumulating still overflows its allotted space (and that the family still puts everything needing your attention on the bench instead of in the box you have provided).

QUERIES AND REPLIES

" THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply must also be published on this page. The following rules must, however, be complied with:

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked " Query " and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

Steam Engine for Model Launch

I am proposing to build a model steam launch and as I have no experience with engines, I wish to purchase a suitable steam plant. I am offered the choice of two engines, one being a single cylinder double-acting slide-valve type, $\frac{3}{4}$ in. bore by $\frac{3}{4}$ in. stroke, and the other a twin cylinder single-acting piston-valve type of the same bore and stroke. It would appear to me that there is nothing to choose between the two in respect of power, as the first uses both strokes effectively, while the second only uses one stroke in each cylinder. Can you advise me which is the most suitable for my purpose?

W.B. (Horsham).

As you surmise, there is little to choose in effective power output between a single-cylinder double-acting engine and a twin cylinder single-acting engine of identical bore and stroke, assuming that they both operate at the same steam pressure and speed. Under normal working conditions, either type has a wide range of flexibility, and for a given steam-generating capacity of the boiler, will produce much the same power. For boats having a moderate performance, with no attempt to force the pace, the single-cylinder engine will do all that is required, and is probably the more interesting type, as all working parts can be seen. But if the object is to obtain maximum performance by raising the boiler pressure, and thereby the r.p.m. of the engine, the twin-cylinder single-acting engine is usually found preferable, owing to the improved balance and reduced reciprocating weight of pistons, etc.; such engines are usually enclosed, and can therefore be lubricated more effectively at high speed. The absence of packing glands enables friction to be reduced, and still further mechanical efficiency results from the use of a balanced piston valve of the type usually employed in single-acting engines ; though this form of valve can also be used in the orthodox double-acting engine, it is much less common than the flat slide-valve, which is capable of causing excessive friction if the working pressure is high.

Model Locomotive Lead

I have schemed out a Stephenson valve-gear for my model locomotive, but cannot decide what lead the valves should have. At the " M.E." Exhibition, the driver of one of the locomotives on the passenger-carrying track told me that his engine had negative lead. Would you please say what is the advantage of this? It seems to me to be all wrong.

S.T.T. (Bolton).

This is quite an old question now, and has been discussed at various times in our pages. There is no particular advantage in negative lead as such; where it is present in locomotives, it indicates that the designer required a definite and predetermined amount of lead when the gear was notched up. For example, on the old Great Western " Saint " class 4-6-0 engines, a lead of about $\frac{3}{16}$ in. was required when the gear was notched up to 25 per cent. cut-off, the usual running position. In the standard Great Western layout of Stephenson gear, with its short eccentric-rods, this meant that the lead became negative when the gear was dropped into the full-gear position. With longer eccentric-rods, there is less variation in lead as the gear is notched up, and therefore more likelihood of positive lead being present when the gear is in the full-gear position.

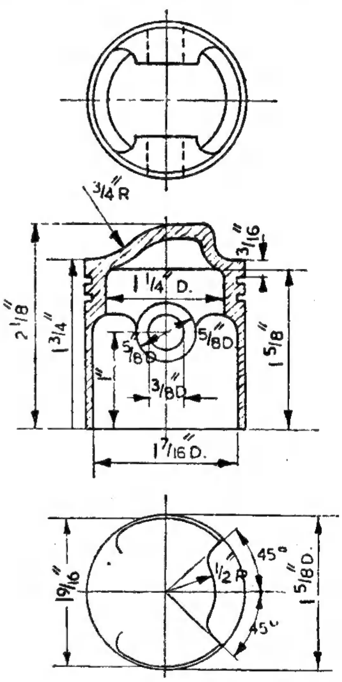
So far as your model locomotive is concerned, you do not say what size or type it is, so we cannot state any definite figures for you to work to ; but we would add that if you intend to give lead to the valves when the gear is in the full-gear position, you should be careful that you are not getting too much lead when the gear is notched up. Much depends upon the bore of the cylinders and the size of the steam ports, and if you have long eccentric-rods, we suggest that a lead of 1/15 of the valve-lap, when the gear is in full-gear position should be satisfactory. All this is assuming that you are using adjustable eccentrics; if your eccentrics are solid with the crankshaft, you will not be able to vary the lead, once the gear is assembled.

Machining 2-stroke Pistons

I am constructing the " Busy Bee " 50 c.c. engine, but have encountered a difficulty in the machining of the top surface of the pistons. Will you please inform me how the hollowed-out surface on the transfer port side of the deflector is machined?

G.H. (West Ardsley).

It is not intended that the top of this piston should be machined, as the contour of the piston is cast to the finished shape, and should



only require cleaning up to eliminate any definite roughness. It could, however, be machined on the surfaces indicated by the use of a spherically-ended milling cutter or rotary file held in a milling spindle, the piston being held in the chuck, and rotated through the necessary arc. This has not, however, been done with the engines of this type that we have constructed.